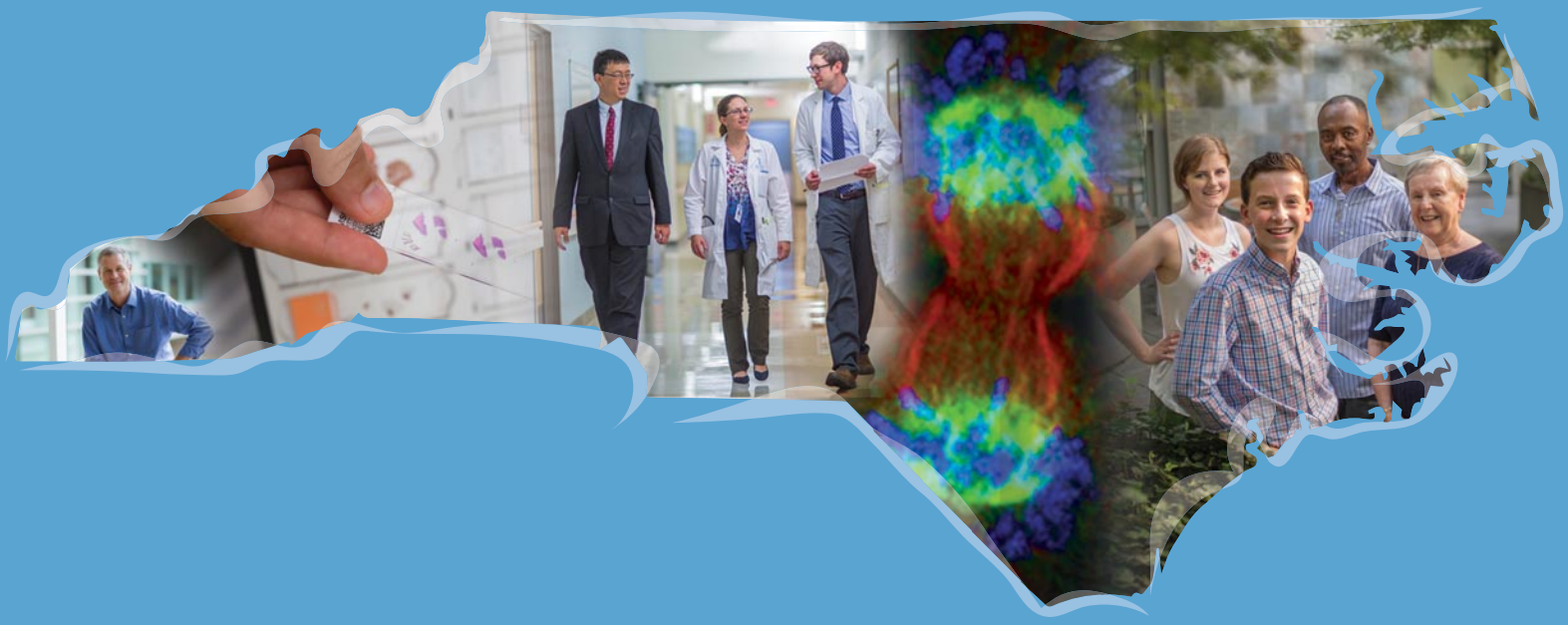


UNIVERSITY CANCER RESEARCH FUND
2017 LEGISLATIVE REPORT

Annual Financial Report to the Joint Legislative Education Oversight Committee and the Office of the State Budget and Management
Submitted November 1, 2017 in accordance with G.S. 116-29.1

UNC LINEBERGER

www.UNCLineberger.org/ucrf

Message from the Chair

At UNC Lineberger Comprehensive Cancer Center, researchers are working every day to change the way cancer is understood and treated. Thanks to the University Cancer Research Fund (UCRF), UNC Lineberger is making an impact all across North Carolina and survival rates are climbing. Despite our progress, however, more than 50,000 people in our state were diagnosed with cancer last year and cancer is still the leading cause of death in North Carolina.

As chair of the UCRF Committee, I am pleased to share our annual legislative report, which details some of the innovative and impactful ways the state's investment in the UCRF is helping citizens throughout our state.

For example, this year we launched the Carolina Cancer Screening Initiative, which works with community partners to improve cancer-screening rates. We are also expanding our lay patient navigator training program, which was created with UCRF support to help train lay navigators to link cancer patients with important resources like transportation, counseling and financial assistance. We are extending this program to 11 other centers/hospitals throughout the state thanks to a Duke Endowment grant. In addition, we are creating truly innovative approaches to cancer immunotherapy and bringing these novel clinical trials to North Carolina.

In addition to directly helping cancer patients, the UCRF continues to generate increasing benefits for our state's economy. These widespread economic benefits continue to grow, and in Fiscal Year 2017 they include:

- Generating almost $420 million in total economic impact in North Carolina – a return of more than $9 for every dollar invested;
- Creating and supporting more than 2,602 jobs through both indirect and induced impacts of those direct jobs and the spending generated from the UCRF within North Carolina; and,
- Leveraging UCRF funds to attract more than $137.7 million in federal research grants to improve health; and providing nearly $14.5 million in local and state tax revenue.

Our goal continues to be improving health outcomes for cancer patients through research while striving to pinpoint ways to eradicate this disease entirely. On behalf of our public health, fundamental and clinical researchers – and most importantly, on behalf of all of the North Carolinians we serve – thank you for your continued support of the UCRF.

Sincerely,

Carol L. Folt, PhD
Chair, Cancer Research Fund Committee

INTRODUCTION

UNIVERSITY CANCER RESEARCH FUND

2017 LEGISLATIVE REPORT

UNC LINEBERGER

INTRODUCTION

Ten years ago, cancer overtook heart disease as North Carolina's leading cause of death. That year, the North Carolina General Assembly created the University Cancer Research Fund, a landmark investment in cancer research aimed at defeating a disease that affects nearly 40 percent of North Carolinians at some point in their lives.

The UCRF underwrites the recruitment, retention and research of faculty members who are world-class experts in their fields. These faculty members lead UNC Lineberger's efforts to better understand, prevent, diagnose, and treat cancer – helping the cancer center earn an "exceptional" rating – its highest ever – from the National Cancer Institute in 2015.

The quality of UNC Lineberger's faculty – and the UCRF's impact – was underscored this spring when President Trump named Norman E. Sharpless, MD, as the next director of the National Cancer Institute. This is a wonderful, well-deserved honor for Sharpless, who had served as UNC Lineberger's director since 2014.

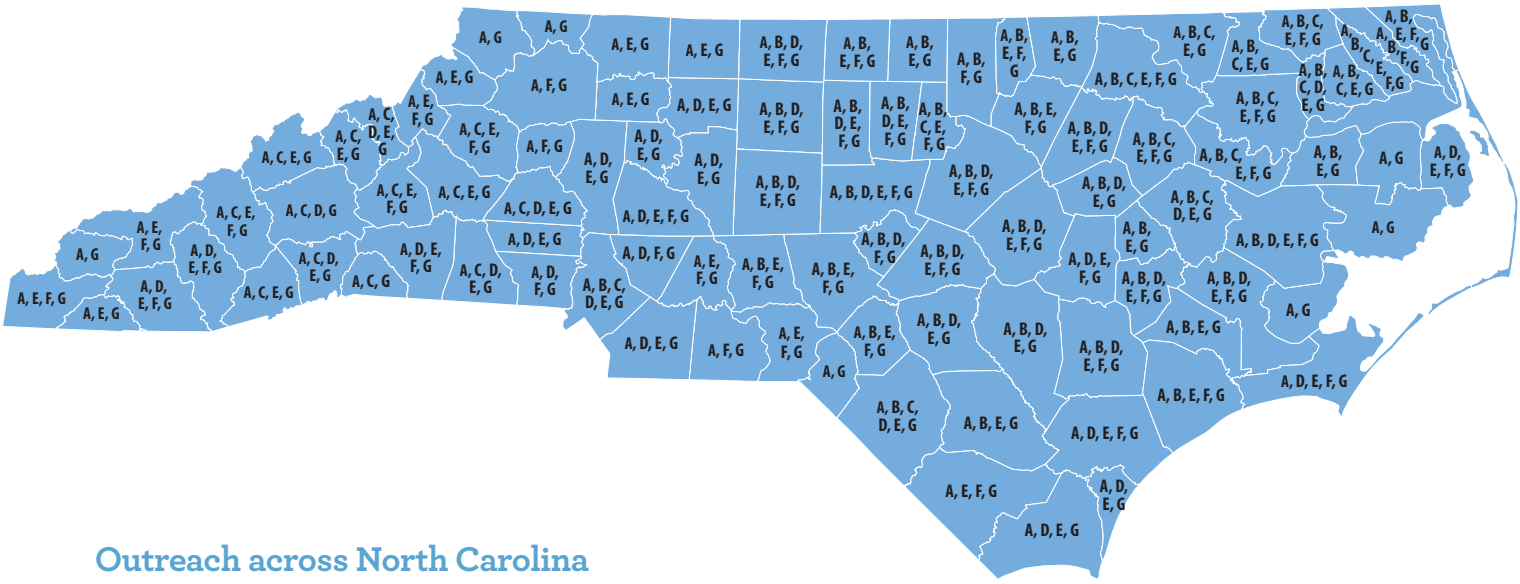
The UCRF also supports innovative technologies, infrastructure and other core resources that have allowed UNC Lineberger to extend innovation and cancer prevention and therapeutic advances through community partnerships throughout North Carolina.

With UNC Lineberger's strong historical mission of education, research and public service, one of our main priorities has been to make sure UCRF resources are benefiting patients and communities statewide. Indeed, one of the key questions that we've asked ourselves about every potential use of the UCRF since its inception is: Will it address North Carolina's needs in terms of the goal of reducing the cancer burden in the state? We are proud to report that in the decade since the UCRF was established, it has supported research projects, outreach efforts, and community-based interventions that have touched all 100 counties.

REDUCING THE BURDEN OF CANCER IN NORTH CAROLINA

The University Cancer Research Fund enables UNC Lineberger faculty to develop and implement cancer research and outreach initiatives that impact all 100 counties in North Carolina. These programs, which address cancer disparities, outcomes, screening rates, survivorship care, and prevention, include:

- Rolling out lay patient navigator programs at 11 cancer centers and hospitals across the state
- Partnering with community health organizations in areas disparately affected by cancer to identify and address barriers to cancer screening programs
- Developing and expanding the cancer nursing workforce in North Carolina by providing cancer-focused training for nurse practitioner students
- Tracking and assessing cancer incidence, mortality, and burden in North Carolina to generate actionable insights on cancer risk factors, prevention and outcomes



Outreach across North Carolina

A. Cancer Data Resources

- Carolina Breast Cancer Study, Phase 3
- Cancer Information and Population Health Resource (CIPHR)(ALL COUNTIES)
- UNC Health Registry(ALL COUNTIES)

B. Understanding Cancer Disparities

- Geographic Variation of Colorectal Cancer Mortality in North Carolina: A Spatial Analysis Approach
- Comparative effectiveness of breast cancer screening and diagnostic evaluation by extent of breast density
- Risk based breast cancer screening and surveillance in community practice
- Reproductive health after adolescent and young adult cancer
- Effect of HPV Self-Collection on Cervical Cancer Screening in High Risk Women
- Understanding the relationship between environmental inorganic arsenic and prostate cancer
- Racial disparity and factors that influence receipt of health care following prostate cancer diagnosis
- Racial difference in financial impact of prostate cancer treatment and outcome

C. Cancer Screening

- Carolina Cancer Screening Initiative
- A randomized trial of a culturally-adapted colorectal cancer screening decision aid designed for American Indians
- Mailed reminders plus fecal immunochemical testing (FIT) to increase colorectal cancer screening among patients of Roanoke Chowan Community Health Center

D. Cancer Survivorship

- Efficacy of a Couple-focused, Tailored, Symptom Self-Management mHealth Intervention for Prostate Cancer Patients and Partners
- Improving Cancer Survivorship Care across North Carolina: Training Group Intervention Leaders

E. Clinic-based Prevention

- CHANGE
- Normalizing Preteen HPV Vaccination with Practice-based Communication Strategies
- Duke – UNC Tobacco Treatment Specialist Credentialing Program

F. Community-based Prevention

- Get Real & HEEL: Remote Video Participation
- Our Year of Healthy Living: A Social Marketing Intervention for Child Care & Home
- Care2bWell: A Worksite Physical Activity & Wellness Program for Child Care Staff
- Expanding Go NAP SACC's Reach through Online Consultant Support Tools
- Lose-Now-NC: Feasibility of a large group format community weight loss program coupled with Internet support
- North Carolina BEAUTY and Health Project 2
- FIT Shop: Promoting Physical Activity in Black Barbershops
- Planning for Sustainability of Evidence based Interventions
- Reducing Disease Risk Factors in Rural Communities in NC
- Mentoring in Community-Engaged Approaches to Address Disparities

G. Improving Treatment Outcomes (ALL COUNTIES)

- NC ProCESS
- Impact of Geographic Region, Treating Facility, and Physician Network Characteristics on Outcomes for Patients with Acute Leukemia and Multiple Myeloma in North Carolina

The Cancer Research Fund Committee has published regular reports on the UCRF's supported activities since 2008. In 2011, the General Assembly mandated an annual financial report that includes the UCRF's effects on the state's economy, details on expenditures of UCRF monies and outside funds leveraged by UCRF support, and other performance measures.

This is the seventh financial report submitted pursuant to the legislative requirement. It demonstrates that the UCRF continues to generate significant economic benefits for the state of North Carolina, such as:

- **Directly supporting nearly 1,100 employees in FY 2017**
- **Supporting more than 1,500 other jobs indirectly through increased extramural funding and the impact of those direct jobs and associated spending in North Carolina**
- **Having an overall economic impact of $419.7 million in FY 2017, including $224.2 million in direct impact and $195.5 million in indirect and induced effects**
- **Generating a total impact of $2.4 billion in the decade since UCRF's inception**
- **Producing a return on investment exceeding a 9 to 1 return in FY 2017**

In addition to these economic benefits, the UCRF is having direct positive effects for patients and providers in North Carolina as well as a more general human impact through the continuing advancement of cancer research and care. This report details research highlights that would not be possible without UCRF support and, when fully realized, will reduce the burden of cancer in North Carolina and beyond.

To provide continued oversight and to ensure that these resources are invested responsibly, the General Assembly created the Cancer Research Fund Committee, which adopted a Strategic Plan to target UCRF resources in areas where they can have maximum impact:

- Strategic research priorities in genetics, novel therapies, and outcomes;
- Clinical excellence through selective opportunities that enable UNC scientists to continue to be a leader in a rapidly changing field of research; and
- Critical infrastructure such as technology, training, outreach and other core resources.

The UCRF's importance in ongoing research, infrastructure and public service is complemented by the state's two major capital investments in cancer care. The N.C. Cancer Hospital, which opened in 2009 as the clinical "home base" for UNC Lineberger's research initiatives, serves patients from all 100 counties. More than 10 percent of the state's new cancer patients are seen at the hospital, and each year there more than 135,000 cancer patient visits. Marsico Hall opened in 2014 as a multidisciplinary collaborative research facility, housing cutting-edge technology and equipment that further accelerates our research capabilities.

The UCRF has been an incredible investment that has generated significant benefits – not only the economic impact, but also the improved research and care for patients and public health in North Carolina. It stands to pay even greater dividends as measured by improved human health and as UNC Lineberger continues to be a national leader in the fight against cancer.

FACULTY IMPACT: RESEARCH AND SERVICE

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UNC Lineberger's Norman Sharpless named National Cancer Institute director

President Donald Trump appointed **Norman E. Sharpless, MD**, UNC Lineberger director and Wellcome Distinguished Professor in Cancer Research, as director of the National Cancer Institute. Sharpless was officially sworn in Oct. 17.

"This appointment is a true testament to Ned's leadership and achievements, both as a researcher and clinician, and it speaks to UNC's commitment to attracting and recruiting the best faculty and developing them to become leaders in their field," said Shelley Earp, MD, who returned to his former role as director of UNC Lineberger in the interim. "Ned is an excellent example of the type of talent we seek out and cultivate, and we are thrilled that he is leading our nation's fight against cancer."

Sharpless is internationally recognized for his research into how normal cells age and undergo malignant conversion. He also was an attending hematologist oncologist at N.C. Cancer Hospital.

A native of Greensboro, Sharpless was a Morehead-Cain Scholar at UNC-Chapel Hill, where he earned his undergraduate degree in mathematics (with distinction) and his medical degree (with honors and distinction) from the UNC School of Medicine. He completed his residency training at Massachusetts General Hospital and his clinical and research fellowship in hematology and oncology at Dana-Farber/Partners Cancer Care in Boston. He returned to Chapel Hill to accept a UNC Lineberger faculty appointment in 2002 as a junior faculty member. His rapid rise to the nation's top job in cancer as NCI director is a testament to the talent and faculty development program at UNC Lineberger, which is funded by UCRF.

Program trains future cancer nurses today

Since 2009, **Deborah K. Mayer, PhD, RN, AOCN, FAAN**, oncology coordinator at the UNC School of Nursing and director of cancer survivorship at UNC Lineberger, has provided cancer-focused training for nurse practitioner students. This has included two core courses, two seminars and a master's paper or project that centered on cancer.

Mayer, who receives UCRF funding support, said this program is a key investment in developing and expanding the cancer nursing workforce in North Carolina. The program already has trained 37 nurse practitioners, and another 13 are in the pipeline to graduate in 2018 and 2019.

Based on requests from students, and to address primary care provider needs for oncology content, Mayer has developed a new course for the spring of 2019 to provide nurse practitioner, physician assistant, and other graduate students a foundation in cancer care for the non-oncology specialist. The oncology program recently created a competitive six-week nursing fellowship for undergraduate nursing students who have an interest in oncology. Five student nurses have completed this program.

"Despite improved cancer prevention programs, we expect to see a greater number of people diagnosed with cancer as our population ages," said Mayer. "If we want to meet the care needs of cancer patients in the future, it is critical we are focused today on attracting and training more nurses and skilled care givers in the field of cancer care."

Susan G. Komen, Breast Cancer Research Foundation recognize Charles Perou with its top scientific honor

Susan G. Komen presented its highest scientific honor, the Brinker Award for Scientific Distinction, to UNC Lineberger's **Charles M. Perou, PhD**. Perou was recognized for cancer genomics research showing that breast cancer can be classified into different molecular subtypes, a finding that has had important clinical value.

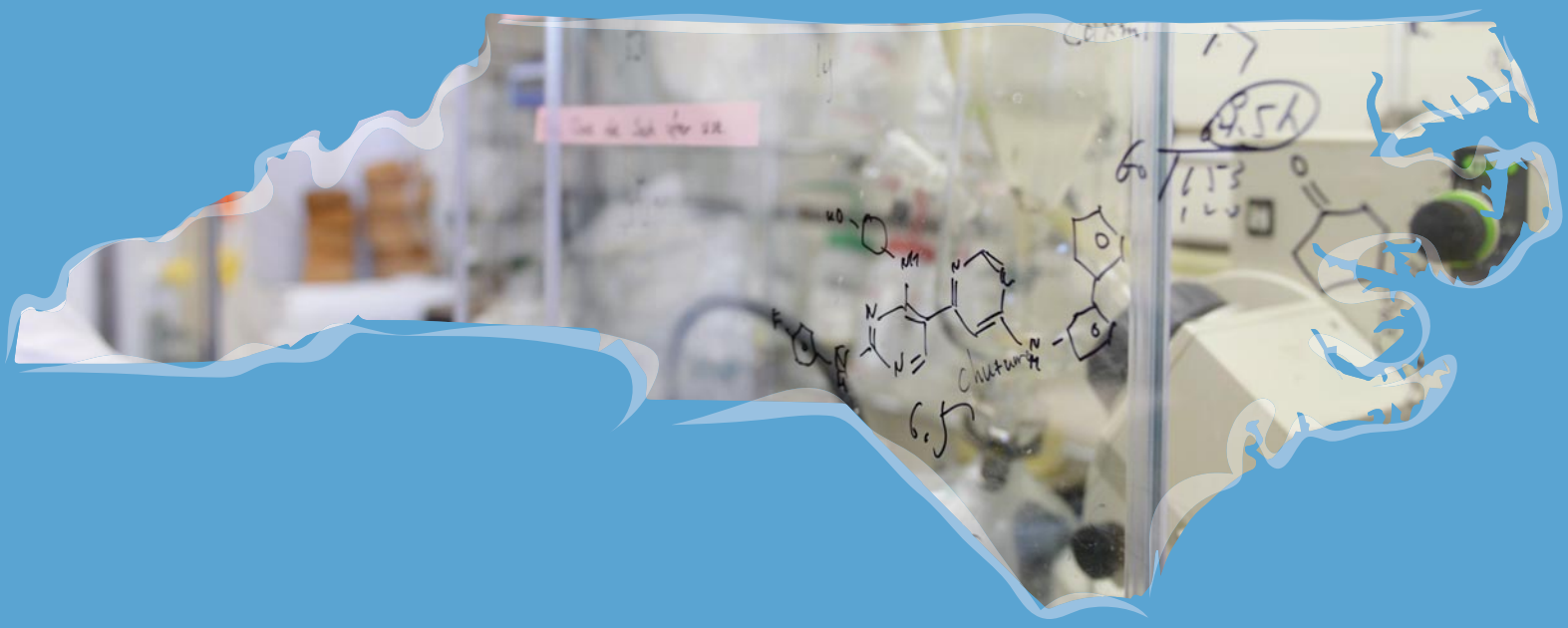
Earlier in the year, the Breast Cancer Research Foundation honored Perou with the Jill Rose Award, its top recognition for excellence and scientific achievement in innovative breast cancer research. He is the first scientist to receive both awards from the country's two top breast cancer foundations in the same year.

"It is extremely gratifying to receive these awards," said Perou. "It means a great deal to me to know that Susan G. Komen and the Breast Cancer Research Foundation, and its associated scientists, think this highly of my research. This only gives me more energy to work harder towards a cure."

Perou, co-program leader of the UNC Lineberger breast cancer research program. has studied the genetic underpinnings of breast cancer for nearly two decades. His scientific contributions include the characterization of the diversity of breast tumors, which demonstrated that breast cancers can be classified into different molecular subtypes.

That critical finding led to the discovery of the basal-like/triple-negative breast cancer subtype, which he has continued to study. Perou and his colleagues also have discovered that breast cancer subtypes were of prognostic and predictive value, and have associated specific genetic mutations with specific breast cancer subtypes.

Perou is the second UNC Lineberger member to receive the Brinker Award. Komen presented Hyman B. Muss, MD, director of the UNC Lineberger's Geriatric Oncology Program and the Mary Hudson Distinguished Professor in the UNC School of Medicine Division of Hematology and Oncology, with the Brinker Award for Scientific Distinction in Clinical Research in 2012 for his critical contributions to the treatment of breast cancer – in particular, the treatment of breast cancer in older women.



ECONOMIC IMPACTS

UNIVERSITY CANCER RESEARCH FUND
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UNC LINEBERGER

ECONOMIC IMPACTS

To determine whether the UCRF is achieving its goal of stimulating North Carolina's economy, UNC Lineberger again hired Tripp Umbach, a nationally respected consulting firm, to estimate the UCRF's economic impact for Fiscal Year 2017. Tripp Umbach examined the UCRF's immediate impact on state income growth and employment. The Fund's overall economic impact was estimated as the sum of its direct and indirect and induced impacts (see the full report in the Appendix). Direct impact resulted from two major sources: expenditures from the UCRF itself, and the expenditure of UCRF-attributable research funds awarded to UNC by federal, foundation and other sources. The indirect and induced impact was calculated by applying standard multipliers to direct expenditures.

For FY 2017, UCRF's total allocation was $46 million. Using standard methodologies, Tripp Umbach estimated that in FY 2017 the UCRF:

- Had an overall economic impact of $419.7 million, including $224.2 million in direct spending and $195.9 million in indirect and induced impact attributable to external grant funding.
- Generated more than $9 in economic impact for every UCRF dollar expended.
- Supported 2,602 jobs, including the direct support of 1,096 jobs and an additional 1,506 jobs through the increased extramural funding and the indirect and induced impacts of those direct jobs and the spending generated within North Carolina.
- Resulted in nearly $14.5 million in tax revenues to North Carolina.

Tripp Umbach has been used for economic analysis since FY 2013. Prior to that, economic impact analyses were performed by SRA International and the UNC Center for Competitive Economies (Frank Hawkins Kenan Institute of Private Enterprise) using slightly different methodology. Tripp Umbach has used their methodology to calculate the overall impact of UCRF in this first decade. The FY 2017 amount brings the total economic impact of the UCRF to more than $2.4 billion since its inception.

Faculty Job Creation and Retention

Great faculty are at the core of the UCRF's successes. They spearhead the groundbreaking research that leads to important advancements in cancer treatment, prevention and early detection. They also hire staff, train students and fellows, purchase equipment, and earn research funding from other sources both inside and outside North Carolina. Since the UCRF was created in 2007, it has had a tremendous positive impact on cancer research faculty:

- **Recruitment:** The UCRF has supported the recruitment of 14 faculty this year, and 185 since its creation. These faculty are developing a wide range of research programs in cancer genomics, nanomedicine, quantitative biology, health outcomes, multiple cancer types, health communications, and other areas critical to improving cancer prevention, diagnosis and treatment in our state.
- **Retention:** UCRF support has enabled the retention of 2 faculty this year and 41 total since 2007, allowing us to keep top talent at UNC where they can continue their research and clinical care.

Extramural Funding Growth

Almost all extramural funds come to UNC from outside North Carolina, adding significantly to the state's economy. The UCRF's Strategic Plan establishes extramural research funding – particularly competitive federal funding – as a key measure for UCRF success. UCRF support is keeping the state at the forefront of research

nationally and leveraging significant amounts of extramural research funds for North Carolina. Key trends include the following:

- FY 2017 funding from outside sources that is directly attributable to the UCRF totaled $177.8 million in annual total cost dollars.
  - This amount is based on a snapshot of active attributable extramural funding held by UCRF-recruited, -retained and -supported faculty in the first quarter of FY 2017. The dollars represent one year of funding. A complete list of the awards is included in the Appendix.
  - The positive effects of faculty recruitment and retention, technology enhancement, and developmental projects have accumulated. The UCRF-attributable extramural funding has risen from $5 million in FY 2008. By FY 2011, it was $69 million. The nearly $178 million in attributable extramural funding in FY 2017 continues an upward trend. Many of the currently active awards will continue for several more years, and we fully expect new awards to add to the total.

Intellectual Property, Innovation, and Entrepreneurship

By encouraging research innovation, the UCRF has promoted entrepreneurship and has created jobs and spinoff companies. The UCRF collaborates with UNC's North Carolina Translational and Clinical Sciences Institute to emphasize an entrepreneurial mindset at UNC, and supports specialized staff to maximize the development and licensing of university intellectual property. More than 40 startup companies have launched or expanded their enterprise relying on research generated in part by the UCRF – and attracting external grant support, drawing venture capital investments, and creating private-sector jobs as a result.

Two spinoff companies hit significant milestones this year: G1 Therapeutics, Inc., a clinical-stage oncology company in Research Triangle Park co-founded by former UNC Lineberger Director Ned Sharpless, MD, raised $108.6 million in an initial public offering of its stock. An early stage company, Capio Biosciences, Inc., co-founded by UNC Lineberger member Andrew Wang, MD, raised $2.9 million in private investment.

"We were successful in raising funding and moving this company forward because of the innovation culture at UNC and at UNC Lineberger," Wang said. "Our ultimate goal is to develop a device that provides a highly reliable biomarker of many cancers that will help with treatment decisions, allowing for personalized medicine, and, eventually, a reduction in health care costs."

RESEARCH IMPACTS

UNIVERSITY CANCER RESEARCH FUND
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UNC LINEBERGER

RESEARCH IMPACTS

UNC's reputation as a leader in cancer research is a direct result of the strength of its faculty. Lineberger faculty and staff are leading a range of programs based in Chapel Hill, as well partnering with hospitals, clinics and public health organizations in all 100 counties in North Carolina, to improve cancer outcomes in our state. This includes research studies focused on cancer screenings, cancer survivorship, community-based prevention, treatment outcomes and cancer disparities.

UNC Lineberger faculty are investigating complex, complicated issues that would go largely unaddressed by industry. Understanding why some people with cancer respond better to treatment than others, uncovering the barriers that prevent some people from undergoing routine cancer screenings or identifying what prevents people from following up with cancer care providers will result in better cancer care and improved outcomes in our state.

UNC Lineberger has been a National Cancer Institute-designated cancer center for more than four decades. NCI granted Lineberger an "exceptional" rating in 2015 – the highest that a cancer center can earn – and cited the UCRF as a significant reason UNC earned the Institute's top rank.

To optimize UCRF resources to have the most meaningful impact, when the UCRF reached its authorized funding amount in 2009, the Cancer Research Fund Committee adopted a Strategic Plan to guide the most effective and responsible use of the state's investment. This section of the annual report highlights noteworthy successes in each of the Strategic Plan's primary areas.

1. **Research Priorities:** The Plan targets three specific research priorities where with focused investment in major scientific programs, disease-based initiatives, or cutting-edge research platforms, UNC could have substantial impact and become a world leader:
   - **Understanding the Role of Genetics in Cancer Causation and Treatment** – to discover the genes that predispose families to cancer and that predispose cancer patients to poor treatment outcomes – especially by looking for the various genetic mutations in specific cancer subtypes that lead to cancer therapy failure.
   - **Developing Novel Therapeutics** – to devise new therapies that are targeted to the specific vulnerabilities of treatment-resistant cancers, to harness the body's own immune system to combat cancer that has spread to other parts of the body, and to develop new ways of delivering treatments that reduce toxic side effects for patients. This research priority relates closely to the genetics initiative, and makes key observations that will be utilized in clinical applications as quickly as possible.
   - **Optimizing NC Cancer Outcomes** – to enhance the quality of oncology and survivor care, and to build population-based datasets that track the occurrence and treatment of cancer across North Carolina in order to support research designed to improve community prevention and early detection. The ultimate goal is to understand North Carolina's cancer problem at a level unprecedented in the nation and to design research interventions aimed at rectifying these problems at the practice, health system and community levels.
2. **Clinical Excellence and Infrastructure:** The Cancer Research Fund Committee recognized the need for UNC to be able to adapt to a rapidly changing field. As a result, the Strategic Plan highlighted the importance of establishing critical infrastructure as well as pursuing selective opportunities, outside of the three general research priorities, where UNC could strive for clinical excellence and have a major impact.

   This allows the UCRF to remain nimble in order to seize research or clinical opportunities as they arise and to provide the top minds in the field with the resources they need. Examples include funds to recruit top

researchers; support of leading-edge technology and equipment for use by multiple faculty members; competitive, innovative pilot projects; and the development of shared research resources. As a result, the UCRF has enabled UNC Lineberger to recruit, retain and support outstanding faculty members with expertise and leadership in several key clinical areas.

The UCRF provides critical resources for cancer research that are not readily obtainable by outside funding, but upon which future progress relies. Investments in imaging, informatics and fundamental research techniques give our clinician scientists the tools they need to improve patient outcomes, while virtual tumor boards and a telemedicine network connect community doctors and hospitals with oncology experts at UNC. UCRF resources provide the opportunity to grow our multidisciplinary excellence in cancer care and to develop a statewide infrastructure that helps bring leading-edge clinical research and applications into community practices and other research institutions across North Carolina.

Research Priority 1: Genetics in Cancer Causation and Treatment

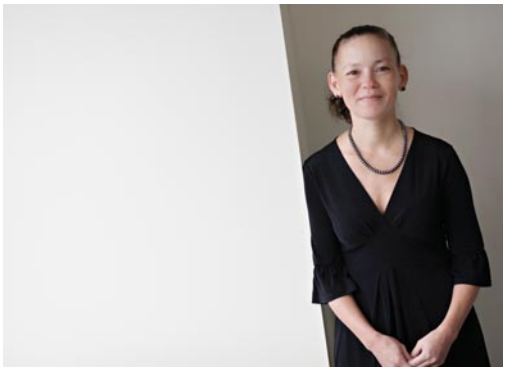
Cancer genetics is one of the most dynamic fields of cancer research. It is the study of how an individual's genetic makeup can influence the risk and development of cancer, and the study of how various types of enzymes, proteins and genetic mutations can affect tumor growth. Thanks largely to UCRF investments in vital research technologies, UNC Lineberger has become a global leader in efforts to transform the way cancers are classified, diagnosed and treated.

A gene product's role in ovarian cancer growth uncovered

UNC researchers have uncovered a genetic "switch" to deactivate a protein that promotes the growth of ovarian cancer, the fifth leading cause of cancer death among American women.

When it's activated, the FoxM1 protein triggers genes that cause cells to replicate and divide abnormally, causing the ovarian cancer. Researchers led by UNC Lineberger's **Michael J. Emanuele, PhD**, assistant professor of pharmacology, found that another protein called VprBP/DCAF1 functions as the "switch" that not only activates FoxM1 – it also can turn it off.

Michael J. Emanuele, PhD



Victoria Bae-Jump, MD, PhD

This finding will direct future studies to explore exactly how VprBP can degrade – and activate – FoxM1, which could lead to a possible therapeutic approach for ovarian cancer. "If we can understand what tips the balance of the regulation of this protein, we might have an entry point for therapeutically inactivating FoxM1 by triggering its destruction," Emanuele said.

Because ovarian cancer is often asymptomatic in its earliest stages, many women are diagnosed with advanced cancer that is more difficult to treat successfully. There is also a high rate of recurrence despite aggressive treatment.

"Few targeted therapies exist for ovarian cancer," said UNC Lineberger's **Victoria Bae-Jump, MD, PhD**, associate professor in the obstetrics and gynecology, who also worked on this study. "VprBP may be a promising target in ovarian cancer, a disease where novel therapeutics are desperately needed to improve outcomes."

Researchers unlock how aggressive breast cancer changes gene expression to resist therapy

Breast cancer cells are evasive, finding ways to bypass drugs designed to stop their unchecked growth. UNC Lineberger researchers have uncovered how a particularly aggressive breast cancer type resists treatment – and, by testing their lab discoveries on human breast cancer cells, also revealed a possible drug combination to help stop cancer growth and prevent resistance.

A team led by **Gary L. Johnson, PhD**, a UNC Lineberger member and Kenan Distinguished Professor in the Department of Pharmacology, used advanced genetic sequencing technologies to uncover how triple negative cancer cells developed resistance to the drug, trametinib, which is one of a class of commonly used anti-cancer drugs called kinase inhibitors. They found that the cancer cells formed thousands of new "enhancers" – DNA sequences bound by molecules such as BRD4 – that turned on specific genes to resist trametinib. Researchers also discovered that pairing trametinib with an investigational drug, which blocks BRD4's ability to help form new enhancers, helped stop tumor growth in experiments in cells and in mouse models.

Gary L. Johnson, PhD

"We were able to actually inhibit the reprogramming of the tumor cells so that they stay vulnerable to the first drug," Johnson said. "In fact, we were able to reverse the development of resistance to trametinib."

Johnson and his colleagues found that their prediction of resistance to these drugs from laboratory models held true in breast cancer patients undergoing short-term treatment with trametinib, lending further support to approaches they are developing to prevent this resistance. While the findings of the possible drug combination were made through preclinical studies, the researchers hope the study will advance to a clinical setting for additional investigation.

"Drug resistance is a major problem in triple negative breast cancer, and is the reason so many promising drugs for this challenging kind of breast cancer have failed," said UNC Lineberger's Lisa Carey, MD, physician-in-chief of the N.C. Cancer Hospital and the Richardson and Marilyn Jacobs Preyer Distinguished Professor in Breast Cancer Research. "This research is shining a bright light on why this happens and how we might fight it. I am really excited about the future for these kinds of treatments."

"Junk" DNA plays role in rare bone cancer

UNC Lineberger researchers have found that short, repetitive sequences of DNA, once considered the "junk of the genome," actually play an important role in the development of Ewing sarcoma, a rare bone and soft tissue cancer that occurs most commonly in children and adolescents.

Ian J. Davis, MD, PhD

In Ewing sarcoma, a deranged gene product typically drives the cancer. But researchers found that the mutant gene product does not work alone; the manner in which repetitive DNA sequences interact with histones often enhance a person's susceptibility to the oncoprotein's attack. This interaction in Ewing sarcoma is similar to that of stem cells, which haven't matured and can still become many types of cells.

"Repetitive elements contribute to cancer development for Ewing sarcoma based on traits that they share with immature cells. This is

one way we think the oncogene capitalizes on a pre-existing environment and offers some insight into why the cancer might have a very specific window during which it could develop," said **Ian J. Davis, MD, PhD**, a pediatric oncologist and researcher at UNC Lineberger and the Denman Hammond Associate Professor in Childhood Cancer at the UNC School of Medicine. "It's kind of like a seed and soil relationship. The oncoprotein 'seed' can only form cancer in the correct stem cell 'soil.'"

Davis and colleagues are now working to identifying treatments that can alter the DNA/histone interaction targeted by the Ewing sarcoma oncoprotein.

Research Priority 2: Developing Novel Therapies

UNC researchers are studying multiple ways to improve treatment methods to better target tumor cells, to activate immune clearance of tumors, and to minimize toxic side effects on non-cancerous tissues. As scientists gain more insights as to how cancer develops and grows, they can strive to find more effective methods of treatment. Reprogrammed cells, nanoparticles and other vehicles for more precise drug delivery are continually evolving. Enrollment in clinical trials gives more North Carolinians access to cutting-edge therapies as part of the drug testing process. The UCRF is instrumental in supporting UNC researchers in the development and testing of new therapies and drug delivery methods that aim to treat cancer more effectively and with fewer toxic side effects.

UNC Lineberger launches innovative cellular immunotherapy program

In the past few years, UCRF funding has been vital in developing a robust program in cellular immunotherapy, or the genetic engineering of a patient's own immune cells to fight their cancer. This is a particularly exciting and dynamic field in cancer therapy with remarkable responses in patient who have no other options. Investments from the UCRF have helped make UNC one of the few facilities in the country where this experimental therapy can be developed and delivered on-site.

L-R: Jonathan Serody, MD, Gianpietro Dotti, MD, and Barbara Savoldo, MD, PhD

In 2015, UCRF funds were used to recruit **Gianpietro Dotti, MD**, and **Barbara Savoldo, MD, PhD**, to UNC to establish and lead the program. Last year, UNC Lineberger completed construction of a new FDA-approved Good Manufacturing Practices (GMP) facility in which to engineer immune cell-based therapies. With the opening of this facility, which was financed by the UCRF, UNC Lineberger is one of only a few academic centers in the United States with the capability to directly test novel genetic modifications of patient immune cells for clinical use and to push the field in new directions.

"The establishment of our cellular immunotherapy program is significant for several reasons," said **Jonathan Serody, MD**, associate director of translational science at UNC Lineberger and a medical oncologist in the UNC Lineberger Leukemia and Lymphoma Program. "First, it provides a dedicated center to rigorously investigate these experimental therapies. Second, it means people who live in Southeastern U.S. can stay closer to home to undergo cellular immunotherapy treatment."

Cellular immunotherapy involves extracting disease-fighting immune cells – called T-cells – from the patient's blood, expanding them out of the body for several weeks, and genetically engineering them to recognize the patient's cancer. The researchers use a modified virus to insert DNA into the T-cells, which helps the T-cells recognize and destroy cancer cells. The hybrid T-cells, called chimeric antigen receptor T-cells or CAR-T cells, are then multiplied by the tens of thousands and infused back into the patient.

UNC has launched two early-stage clinical cellular immunotherapy trials for patients with either Hodgkin lymphoma or non-Hodgkin lymphoma, who lack other treatment options or are at high risk of their disease returning. Additional trials are in development for patients with acute lymphoblastic leukemia, and whose tumors have the CD19 surface marker. The researchers also are planning trials during the next year in multiple myeloma as well as for certain brain cancers.

UNC Lineberger researchers also are working on a novel safety switch that will allow clinicians to "turn off" CAR-T cells if they are experiencing dangerous side effects from the treatment, or if the cancer is gone. The researchers have genetically modified the CAR-T cells to express a protein, Caspase 9, that, when exposed to a specific small molecule that is otherwise inactive in the body, will cause the modified cells to die. This "safety switch" approach will be tested using the UNC CD19 CAR-T therapy in patients with acute lymphoblastic leukemia This is seen as a significant step in enhancing CAR-T therapy safety, and it is made possible through UCRF support.

"We are investigating this promising treatment approach to address areas of critical need for patients who, right now, have few therapeutic choices to try to extend their lives," Serody said.

Study sheds light on why some breast cancers have limited response to immunotherapy

UNC Lineberger researchers have discovered a possible reason that some aggressive breast cancers are unresponsive to certain immunotherapy treatments, even when large numbers of immune cells are present.

Ben Vincent, MD

About 15 percent of breast cancers are an aggressive type called "triple negative," meaning they lack three cell surface receptors that are known to help drive the cancer. In a subset of triple negative breast cancers known as "claudin low," UNC Lineberger researchers found an elevated level of immune cells in and around the tumors and believed this would help the body fight the cancer. However, they found the opposite: "Checkpoint inhibitors," a type of immunotherapy that works by unlocking the immune system's brakes against cancer, were ineffective in this subtype.

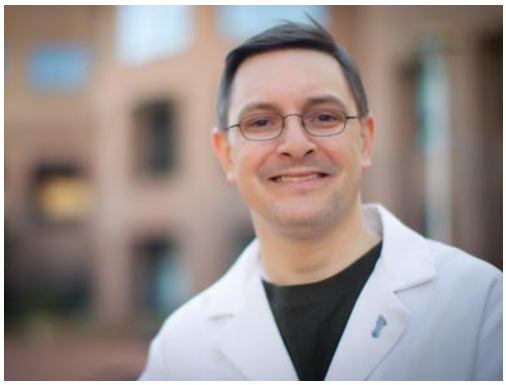
Researchers determined with gene expression analysis that, instead of being flooded with immune cells that attack cancer tumors, claudin-low tumors had a high concentration of regulatory T-cells – a type of immune cell that suppresses the body's defenses. Claudin-low tumors were releasing a chemical signal to attract these regulatory T-cells, preventing the immune system from rejecting the cancer.

Scientists then tested a treatment to deplete the regulatory T-cells, combining it with a checkpoint inhibitor. The combination slowed tumor growth. Their findings could lead to a strategy to improve immunotherapy responses in the "claudin-low" subtype of breast cancer.

These findings underscore the need to study other cancer types at a genomic level to understand differences in response rates to immunotherapy treatments. "This speaks to the mission of UNC Lineberger, which is to conduct groundbreaking basic science research, but always with the mission of extending and improving the lives of patients as our end goal," said **Ben Vincent, MD**, assistant professor of Hematology/Oncology, who is leading a clinical trial testing this strategy to improve responses to checkpoint inhibitors.

Researchers awarded NCI grant to seek new treatments for deadliest adult brain cancer

Backed by a three-year, $1.8 million grant from the National Cancer Institute, UNC Lineberger members are teaming up to develop better scientific models to identify patterns of drug resistance in glioblastoma. Their work will be used to design new drug-combination strategies to treat this common and deadly adult brain cancer.



Ryan Miller, MD, PhD

The project combines scientific expertise from the labs of **Ryan Miller, MD, PhD,** an associate professor in the UNC School of Medicine Department of Pathology & Laboratory Medicine and **Gary L. Johnson, PhD**, Kenan Distinguished Professor in the UNC School of Medicine Department of Pharmacology. They will collaborate with Michael E. Berens, PhD, of the Translational Genomics Research Institute and University of Arizona College of Medicine, as part of an ongoing NCI initiative to build better cancer models.

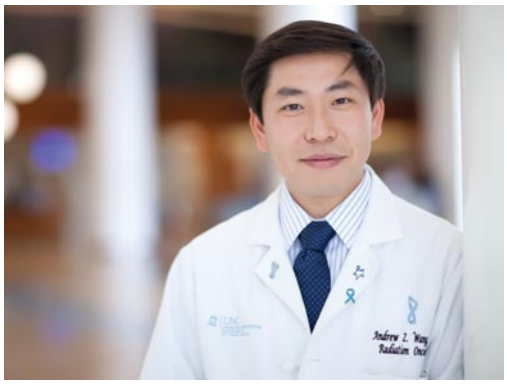
Glioblastoma is the most malignant type of brain tumor. The current standard of care includes surgery to remove the brain tumor, followed by radiation and chemotherapy. Average survival is about 14 months, and ultimately most patients develop resistance to treatment.

The scientists will use genetically engineered glioblastoma mouse models to recreate genetic changes involved in tumor formation and match them with models using actual human cancer tissues. They then will identify which of the 500 protein kinases provide pathways to allow tumor cells to become resistant to drugs. After pinpointing these pathways, they hope to test out different drug combinations to reduce resistance for more effective treatment.

"Sticky" nanoparticles used to boost body's cancer defenses

After radiation, dying cancer cells release mutated proteins into the body. The immune system detects these proteins and kills cancer in other parts of the body – a phenomenon that UNC researchers are hoping to harness to improve cancer treatment.

Led by UNC Lineberger's **Andrew Wang, MD**, associate professor of radiation oncology, researchers are working to improve the immune system's detection of cancer proteins by using "sticky" antigen-capturing nanoparticles. They believe these nanoparticles could work synergistically with immunotherapy drugs designed to boost the immune system's response to cancer.



Andrew Wang, MD

Radiation therapy is commonly used to treat a wide array of cancers. It is believed that after radiation, immune cells are recruited to the tumor site and use mutated proteins released by dying cancer cells to train other immune cells to recognize and fight cancer elsewhere. This effect works synergistically with checkpoint inhibitors, a type of immunotherapy drug that helps the body's own defense system to attack the cancer.

The UNC researchers designed nanoparticles to capture mutated proteins released by tumors. Using preclinical melanoma models, they found that mice receiving the nanoparticle treatment had a higher level of immune response to cancer than mice that did not receive the treatment.

The researchers say a strategy is needed to improve responses to immunotherapy drugs, and to make the responses to the drugs last longer. The next step is to develop a new generation of nanoparticles that are more robust in capturing proteins.

UNC spinoff company that utilizes UCRF-funded research generates more than $108M in stock offering

Ned Sharpless, MD

G1 Therapeutics, Inc., a clinical-stage oncology company in Research Triangle Park that started at UNC Lineberger, raised approximately $108.6 million in an initial public offering of its stock in May.

Founded in 2008, G1 is developing novel therapeutics based on discoveries made in part by former UNC Lineberger Director **Norman E. Sharpless, MD**. The early research that led to the formation of G1 was supported by the UCRF.

G1 currently has several novel therapeutics in various stages of development that target the action of specific protein kinases that are key to cell division and are known cancer drug targets. Trilaciclib is used to protect blood-forming stem cells and enhance immune system function in cancer patients receiving chemotherapy. Research has shown that trilaciclib causes healthy blood-forming stem cells to enter a temporary sleep-like state, halting the cell division process. This shields them against chemotherapy's toxic impact, reducing cellular damage that can put patients at risk for health issues years later. The drug is being tested in three Phase 2 studies in small cell lung cancer and one Phase 2 trial in triple negative breast cancer.

Revolutionary approach for treating glioblastoma works with human cells

Shawn Hingtgen, PhD

In a rapid-fire series of breakthroughs in just under a year, UNC researchers have advanced the development of a potentially effective treatment for glioblastoma, a common and aggressive brain cancer. In laboratory studies, they have successfully converted human skin cells into stem cells that can hunt down and kill human brain cancer when injected into the brain, an important step to moving the approach closer to a clinical trial.

Led by UNC Lineberger's **Shawn Hingtgen, PhD**, an assistant professor in the Eshelman School of Pharmacy, researchers hit a milestone last year when they converted mouse skin cells to stem cells that could hunt down and kill human brain cancer embedded in the mouse brain, increasing time of survival 160 to 220 percent depending on the tumor type. More recently, they have shown that the technique also works with human cells – and that it works quickly enough to help patients, whose median survival is less than 18 months and chance of surviving beyond two years is 30 percent.

"Speed is essential," Hingtgen said. "It used to take weeks to convert human skin cells to stem cells. But brain cancer patients don't have weeks and months to wait for us to generate these therapies. The new process we developed to create these stem cells is fast enough and simple enough to be used to treat a patient."

The key to Hingtgen's treatment is "skin flipping," a technology for creating neural stem cells from skin cells. The original work demonstrating the conversion process won a Nobel Prize in 2012. The Hingtgen approach has improved the speed and yield. But by themselves, these stem cells can only find a tumor and bump up against it – not kill it – so the team had to engineer stem cells that could carry therapeutic agents that the cells can launch at the targeted tumor to kill it, rather than circulating the drug throughout the patient's body and causing unwanted side effects.

"We're one to two years away from clinical trials, but for the first time, we showed that our strategy for treating glioblastoma works with human stem cells and human cancers," Hingtgen said. "This is a big step toward a real treatment – and making a real difference."

Model will help predict if chemotherapy will work for aggressive breast cancer

Patients with triple negative breast cancer have higher response rates to chemotherapy compared with some other subtypes, but chemotherapy often comes with toxic side effects because it more widely attacks all rapidly dividing cells. UNC Lineberger researchers are developing a model that can predict, before treatment, which patients with this form of aggressive breast cancer will respond to chemotherapy.


Katherine Hoadley, PhD

Katherine Hoadley, PhD, assistant professor of genetics, said knowing in advance which triple negative breast cancer patients will respond to chemotherapy could help physicians determine the best course of treatment – including not using chemotherapy if it won't be effective against the cancer, and sparing the patient from potentially harmful side effects.

The researchers developed the prediction model based on the expression of genes from breast cancer samples drawn from 389 patients before treatment and examined how those patients responded to treatment. Researchers will continue to work on the model to improve its accuracy. They plan to include other features of cancer cells in the model such as molecular indicators of how the immune system is responding to the cancer, genetic mutations, and the number of copies of each gene.

"If we can validate our model in future data sets, our work could help us identify patients who are likely to respond to existing, or even less, chemotherapy and those who could benefit from more chemotherapy or novel approaches," Hoadley said.

Blood cancer treatment may age immune cells as much as 30 years

Certain cancer treatments are known to take a toll on patients, causing side effects like fatigue, nausea and hair loss. UNC Lineberger scientists are investigating whether some treatments can cause another long-term side effect: premature aging of important disease-fighting cells.

As a person's age in years is not always a good indicator of his or her health or fitness to receive a treatment, researchers are interested in objective measures of molecular or functional age. UNC scientists studied a group of patients with blood cancer and tracking a protein called p16, a molecular marker that has been linked to an increase in white blood cells as people age. They found that stem cell transplants may be linked to a marked increase in the "molecular age" of these immune cells – comparable to an additional 30 years of chronological age.


William Wood, MD

"We know that transplant is life-prolonging – and in many cases, it's life-saving – for many patients with blood cancers and other disorders," said the study's lead author **William Wood, MD**, a UNC Lineberger member and an associate professor in the Division of Hematology and Oncology. "At the same time, we're increasingly recognizing that survivors of transplant are at risk for long-term health problems, and so there is interest in determining what markers may exist to help predict risk for long-term health problems, or even in helping choose which patients are best candidates for transplantation."

Despite the risk for significant short- and long-term side effects, the researchers say stem cell transplant is an extremely important treatment option. They believe their findings could lay the foundation for future studies into using this age marker to help physicians better quantify a patient's potential risk and benefit associated with a stem cell transplant.

Research Priority 3: Optimizing Cancer Outcomes

The UCRF supports different strategies that reduce cancer risk factors and enhance a patient's ability to access screenings, treatments, and other information that could affect their decisions about cancer care. This has a direct impact on improving outcomes for cancer patients. UNC Lineberger researchers are using robust datasets, community-based research interventions, and strong partnerships with doctors, hospitals and patients to gain a more holistic understanding of cancer in North Carolina. Our research into how patient outcomes vary by geographic, economic and other differences is motivated by the goal of having a meaningful impact for underserved populations across our state. The UCRF has been critical in building rich population-based data resources and funding community-based projects that test the most effective ways to improve prevention and early detection throughout North Carolina.

Helping young adult cancer survivors become more physically active

Research has shown that people who are diagnosed with cancer between the ages of 18 and 39 have a greater risk over time for obesity and chronic health issues, such as diabetes and cardiovascular disease.

UNC Lineberger's **Carmina Valle, PhD**, research assistant professor of health behavior at the UNC Gillings School of Global Public Health, is focused on changing this statistic. She recently received a four-year, $2.2 million National Cancer Institute grant to investigate an approach to promote physical activity among this group of cancer survivors.

Valle will use the funding to support a randomized, controlled trial of whether wearable activity trackers, personalized activity goals, and frequent, individualized text-message support can increase physical activity.

Carmina Valle, PhD

UNC co-investigators on the project include Deborah Tate, PhD, UNC Gillings School professor of health behavior and of nutrition and a UNC Lineberger member, and Donald Rosenstein, MD, director of the UNC Lineberger Comprehensive Cancer Support Program and professor of medicine and psychiatry in the UNC School of Medicine.

Increasing physical activity is a promising behavioral intervention that has positive effects on physical function, body composition, cardiovascular fitness and health-related quality of life among the more than 560,000 young adult cancer survivors live in the United States.

Valle said effective physical activity interventions have used self-monitoring as a behavior change technique to help individuals monitor daily activity, set goals and enhance motivation. The widespread availability of lower-cost wearable activity trackers presents a unique opportunity to simplify self-monitoring and deliver more precisely tailored interventions. However, little is known about the types of support needed to help young adult cancer survivors engage in regular activity and maintain it over time.

To address this research gap, Valle is building on preliminary work completed as part of her doctoral dissertation in nutrition at Gillings that included research that used a Facebook-delivered intervention to increase light physical activity.

"I am excited to have the opportunity to work with young adult cancer survivors and help address their unmet needs," Valle said. "We hope that the findings from this novel study will inform a new generation of high-reach, low-cost, technology-based intervention strategies that have potential to be scalable and to reduce cancer-related chronic illness and health disparities."

Cancer patients who systematically reported their symptoms lived longer

Ethan Basch, MD, MSc

Cancer patients who reported their symptoms to their cancer care providers using a web-based survey lived longer than those patients who did not, according to a study led by **Ethan Basch, MD, MSc**, director of the UNC Lineberger Cancer Outcomes Research Program and professor in the UNC School of Medicine. His study was presented as a feature talk at the American Society of Clinical Oncology's annual meeting this year.

This is the first study to find a survival benefit for patient-reported outcomes, showing that patients who used the symptom-reporting Internet tool lived five months longer than patients who reported their symptoms using standard methods. The five-month survival benefit is greater than that produced in most drug-trials.

"Symptom management is a cornerstone of high quality cancer care, and if we can control patients' symptoms better, that's a win, and it is meaningful in and of itself," said Basch, whose recruitment to UNC Lineberger from Memorial Sloan Kettering Cancer Center in 2012 was supported with UCRF funds. "However, we have demonstrated that systematic monitoring of patient-reported outcomes is linked to quality of life improvements and fewer ER admissions, and people are actually living longer."

The study tracked outcomes for patients with solid tumors who were being treated chemotherapy.

Patients were randomly assigned to self-report 12 common symptoms using a survey on a tablet computer or to use standard symptom-reporting methods, such as calling the doctor's office. Patients in the Internet-based reporting group were sent weekly email reminders about the need to report symptoms between visits. Automatic email alerts were sent to nurses when a patient reported severe or worsening symptoms. Doctors received print-outs of the patient's symptom reports at visits.

Patients who used the computer surveys experienced an overall median survival of 31 months, compared to 26 months for patients who did not use the surveys.

Aggressive breast cancers may contribute to racial survival disparities


Melissa Troester, PhD

A study by UNC Lineberger researchers has confirmed that a higher proportion of aggressive breast cancer subtypes are seen in black women, helping to explain a gap in mortality that exists between black and white women with breast cancer and potentially leading the way to improved treatment approaches to help close that gap.

Scientists analyzed approximately 1,000 invasive breast tumors and confirmed that young black women are more likely to have "triple negative," or "basal-like," breast cancers, a subtype that has no targeted therapy. The study also identified variation by race within a clinical breast cancer type that has the greatest mortality

disparity. Specifically, the researchers found that younger black women with hormone-receptor positive, HER2-negative breast cancer were more likely to have a high risk of recurrence score.

"When we look at a more clinically homogeneous group, such as women who have hormone-responsive, HER2-negative disease, we see pretty significant and biologically important differences between black and white women," said UNC Lineberger's **Melissa Troester, PhD**, the study's lead author and professor of epidemiology in the UNC Gillings School of Global Public Health.

Lisa A. Carey, MD

The study was part of the third phase of the long-standing, seminal Carolina Breast Cancer Study, a population-based study launched at UNC in 1993. A driving motivation for the study has been to understand why African-American women disproportionately die from breast cancer. Since 1993, the study has gathered data on more than 8,000 women from 44 counties in North Carolina.

"If you look at the group of basal-like breast cancers, the burden of this disease is much higher if you're young and black," said UNC Lineberger's **Lisa A. Carey, MD**, physician-in-chief of the N.C. Cancer Hospital. "We believe this is playing a role in racial disparities in outcomes between young and old, and black and white women with breast cancer."

UNC Lineberger program focused on improving screening rates, reducing cancer deaths

UNC's clinicians and public health researchers have allied with community partners to launch an ambitious multi-pronged initiative to improve cancer screening rates in North Carolina, with the goal of reducing cancer-related deaths. The Carolina Cancer Screening Initiative (CCSI), led by **Daniel S. Reuland, MD, MPH**, and **Stephanie Wheeler, PhD**, aims to implement evidence-based cancer screening programs to reduce the cancer burden among North Carolinians.

Colorectal cancer screening effectively reduces cancer deaths. According to the American Cancer Society, screening contributed to a substantial decline in U.S. colorectal cancer deaths between 1976 and 2014. Regular screening is recommended for people aged 50 and 75 years, but the highest rates of colorectal cancer mortality remain primarily concentrated in rural communities, and screening rates are low in some groups – particularly for people who are low-income, on Medicaid, have limited English proficiency, and some minority groups.

One of the major catalysts for the UNC Lineberger effort was a 2015 national study then confirmed by the UCRF-supported Cancer Information & Population Health Resource (CIPHR) that identified an 11-county area of northeastern North Carolina as one of three hotspots in the country with elevated colorectal cancer death rates. An initial focus of CCSI will be to address this geographic disparity, as well as racial and ethnic disparities that negatively impact colorectal cancer screening and mortality, in North Carolina.

Researchers are working to identify and launch initiatives that focus on the specific screening needs of local areas, such as these hotspots. Some of the program initiatives include:

- Working with northeastern countries as well as CIPHR health care leaders to address screening barriers in Hertford and surrounding counties in northeastern North Carolina to improve access to endoscopy services in the region, and securing additional funds for screening programs and implementation studies.
- A partnership with Community Care of North Carolina and the Mecklenburg County Health Department to boost colon cancer screening rates for Medicaid recipients in Mecklenburg County.
- Further testing of an approach that doubled screening rates at community health clinics in North Carolina and New Mexico that largely served patients who were Latino, low income, on Medicaid or lacking insurance. UNC

researchers developed a strategy that used bilingual video about screening options and one-on-one "patient navigation" support to help patients get reminders or scheduled for screening.

- In partnership with the North Carolina American Indian Health Board, investigating individual and sociocultural factors that influence rural Eastern American Indian's colorectal cancer screening decisions. The researchers also are gathering rural Eastern American Indian's suggestions on how to adapt a general population version of a colorectal cancer screening decision aid for their communities.

"We know colon cancer screening is effective, but we also know we're losing opportunities to prevent deaths from colon cancer because screening rates aren't as high as they should be. This is particularly true in vulnerable patient populations," said Reuland.

Wheeler emphasized that successful interventions will be specifically tailored to local needs. "We see huge variation in screening rates because the barriers are different," she said. "To move the needle on colorectal cancer screening, we are going to have to be much more cognizant of the needs of the local population."

New insights into side effects can help prostate cancer patients choose treatments

Ronald C. Chen, MD, MPH

For many men diagnosed with early-stage prostate cancer, treatment decisions are often influenced by concerns about potential quality-of-life issues. A study led by UNC Lineberger member and associate radiation oncology professor **Ronald C. Chen, MD, MPH**, identifies distinct patterns of side effects associated with different treatment strategies that patients could use to help guide their treatment choices.

"There has not been a large-scale comparison of the quality-of-life impact for these modern options, until now," Chen said. "Existing quality of life studies have studied older types of surgery and radiation that are no longer used, and patients need updated information regarding the impact of modern treatment options so they can make informed decisions about the choices they face today."

UNC Lineberger researchers surveyed 1,141 men who were diagnosed with early-stage prostate cancer. They compared patients' self-reported quality of life related to bowel, urination, and sexual function across four treatment options. Prostatectomy was linked to higher sexual dysfunction and urinary leakage than the other options. External beam radiotherapy and brachytherapy caused more short-term urinary tract obstruction and irritation, while external beam radiotherapy was linked to more short-term bowel symptoms. For the group of men who chose active surveillance, urinary issues and sexual function worsened over time. This is likely partly due to aging, and partly due to some men who experienced cancer progression that necessitated treatments that caused these side effects.

"With all of the modern treatment options, patients should have up-to-date, accurate and realistic expectations about the frequency of side effects from treatment," Chen said. "We found that the different treatment options have trade-offs in side effects. Each patient can look at these data to see what they care about most."

Measuring patients' muscles to predict chemotherapy side effects

Chemotherapy has long been the standard treatment for many cancers, but its clinical benefits often come with well-documented side effects. Doctors say the challenge is knowing which patients will experience these side effects, and to what extent – but a new tool developed at UNC could help doctors better identify patients at high risk for serious side effects.

Hyman B. Muss, MD

UNC Lineberger researchers found that low measures of muscle quality and quantity in patients with early-stage breast cancer were linked to serious side effects and hospitalizations. The researchers believe that measuring muscle mass and quality could predict which patients will experience side effects from chemotherapy, and could help doctors determine more appropriate drug doses.

Using medical data from 151 patients treated for early breast cancer at the N.C. Cancer Hospital between 2008 and 2013, **Hyman B. Muss, MD**, the Mary Jones Hudson Distinguished Professor and director of the UNC Lineberger Geriatric Oncology Program, and his colleagues found that 50 patients experienced serious chemotherapy toxicities. Patients with low muscle quality/quantity had higher risk of blood-related toxicities, gastrointestinal side effects and neuropathy – and had twice the risk of hospitalization. Compared to other body composition measures such as body mass index, the skeletal muscle gauge was the most predictive of toxicity.

Muss said their findings could help clinicians to more accurately determine chemotherapy dosing, which could help lower the risk of treatment side effects. "We need better ways of predicting who might be hospitalized for treatment side effects. If we can give a little less dose initially, we might be able to lower toxicities without sacrificing effectiveness."

Study raises concerns about timely follow-up to positive mammogram for the uninsured

UNC Lineberger researchers have found that younger, uninsured women in North Carolina had higher odds of missing a 60-day window for getting follow-up after an abnormal mammogram, even though research underscores the importance of timely follow-up.

Louise Henderson, PhD

The study, led by **Louise Henderson, PhD**, a UNC Lineberger member and assistant professor in the Department of Radiology and UNC Gillings School of Global Public Health, showed that uninsured women under age 65 who received their mammogram at community screening clinics in North Carolina also were less likely to get follow-up within a year of a positive mammogram. Specifically, they had 60 percent higher odds of not having follow-up within the recommended 60 days of a positive mammogram. Even after a year, they were still 53 percent less likely to receive follow-up.

"If we're going to use mammography to screen women for breast cancer, we need to make sure that women with a positive result receive the needed follow-up care, regardless of her insurance," Henderson said. "As expected, women without insurance may need more support to make sure they get timely follow-up care."

About 40 million mammography exams are conducted in the U.S. each year. Previous studies have found that one in 10 mammograms require additional follow-up, although the majority do not result in cancer diagnosis. Another study found that a three-to-six-month delay to treatment from symptom onset was linked to larger tumor sizes at diagnosis, and lower survival.

Snuffing out illegal online tobacco sales to minors

UNC Lineberger's **Rebecca Williams, MHS, PhD**, has studied the online sales of cigarettes and other tobacco products for nearly two decades. Through her research, including a recent paper in Tobacco Control, she has uncovered the ways the industry has gotten around government oversight, especially as it applies to sales to minors.

Rebecca Williams, MHS, PhD

When Williams first started studying online tobacco sales in the late 1990s, she was shocked by how easily minors could buy cigarettes. In a 2003 study, Williams reported that nearly 92 percent of Internet vendors sold cigarettes to underage teens – showing a clear critical need for federal regulations of the online cigarette market. Williams' latest study found that even though many online cigarette sellers have moved overseas in the wake of federal regulation, online tobacco sales to minors continues. Nearly one in three minors were able to buy cigarettes, all delivered by the U.S. Postal Service in violation of federal law, from overseas sellers.

"I think for minors, it's really important we protect them because they are not necessarily old enough to make well-informed decisions about using tobacco products," Williams said. "When it comes to cigarettes, about 90 percent of adult smokers started smoking before age of 18."

Clinical Excellence and Infrastructure

New opportunities for strategically important research regularly develop outside the three Tier 1 Research Priorities. In recognition that cancer advances can happen quickly, another important function of the UCRF is to support competitive and innovative pilot projects, and invest in cutting-edge technology and shared research resources.

Faculty Recruitment

CRITICAL INFRASTRUCTURE

Thomas Alexander, MD, MPH
Assistant Professor
UNC School of Medicine
Department of Pediatrics
Childhood cancers

Anne Beaven, MD
Director, Lymphoma Program
Associate Professor
UNC School of Medicine
Division of Hematology/Oncology
Adult lymphomas

Catherine Coombs, MD
Assistant Professor
UNC School of Medicine
Division of Hematology/Oncology
Adult leukemia

Simon Khagi, MD
Director, UNC Brain Tumor Program
Assistant Professor
UNC School of Medicine
Department of Neurosurgery and Medicine
Brain tumors

Tracy Rose, MD, MPH
Assistant Professor
UNC School of Medicine
Division of Hematology/Oncology
Renal Cancer

Sascha Tuchman, MD, MHS
Director, Multiple Myeloma and Amyloidosis Program
Associate Professor
UNC School of Medicine
Division of Hematology/Oncology
Multiple myeloma

DEVELOPING NEW TREAMENTS

Jeff Aube', PhD
Fred Eshelman Distinguished Professor
UNC Eshelman School of Pharmacy
Drug development

Henrick Dohlman, PhD
Professor and Chair of Pharmacology
UNC School of Medicine
Cancer cell signaling

Melina Kibbe, MD
Chair, Department of Surgery
UNC School of Medicine
Nanotechnology therapy

CANCER GENETICS

Hector Franco, PhD
Assistant Professor
UNC School of Medicine
Department of Genetics
Inflammation effects on breast cancer

OPPORTUNITY

Pablo Ariel, PhD
Director, Microscopy Services Laboratory
Assistant Professor
UNC School of Medicine
Department of Pathology and Laboratory Medicine
Molecular imaging

Janelle Arthur, PhD
Assistant Professor
UNC School of Medicine
Department of Microbiology and Immunology
Microbiome and cancer

OPTIMIZING NC OUTCOMES

Yevgeny Brudno, PhD
Assistant Professor
Joint Department of Biomedical Engineering
UNC-Chapel Hill and NC State University
Drug delivery and immunotherapy

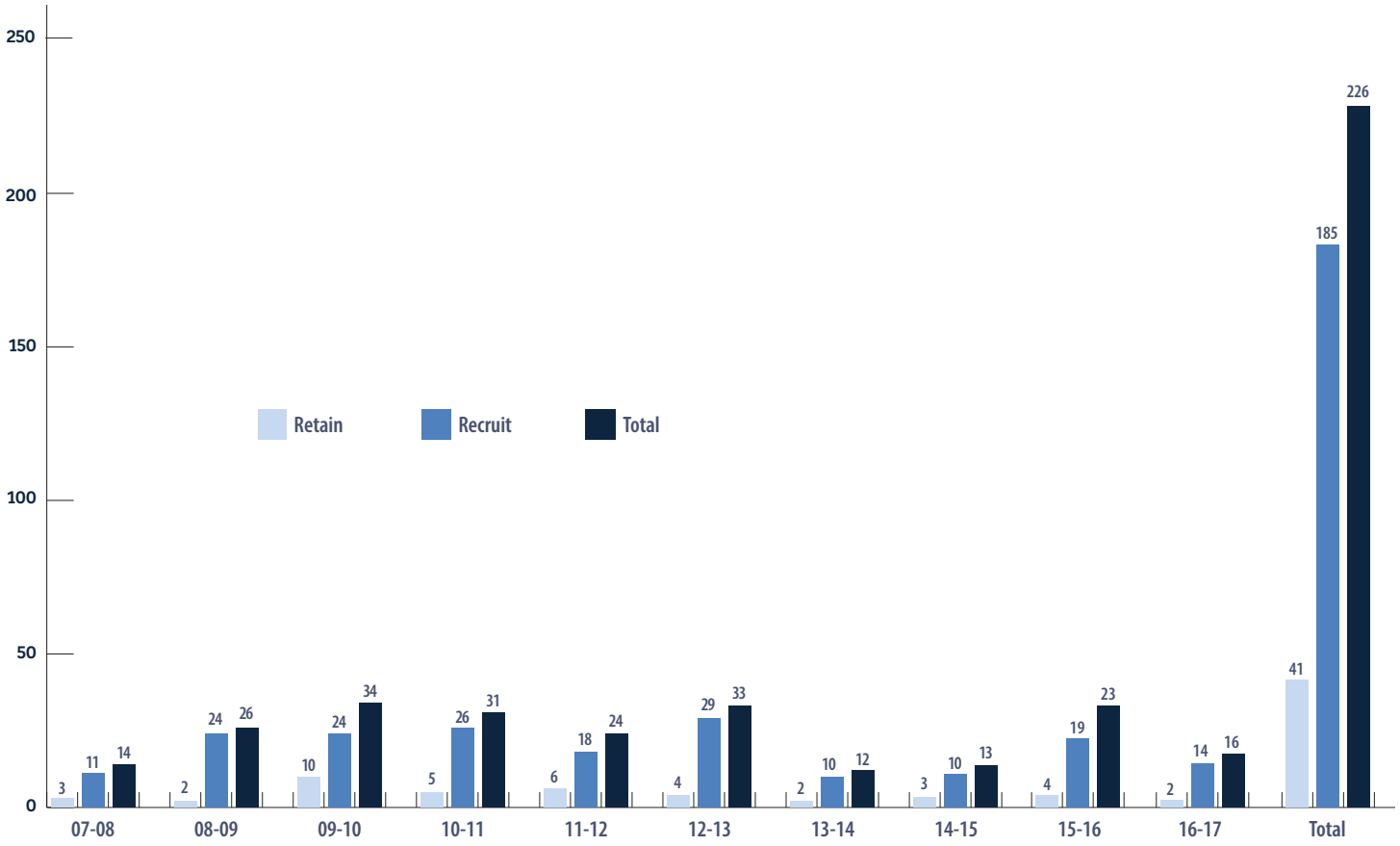
Carmina Valle, PhD
Assistant Professor
UNC Gillings School of Global Public Health
Department of Nutrition
Obesity and cancer

FACULTY RETENTION

James Bear, PhD
Professor
UNC School of Medicine
Department of Cell Biology and Physiology
Cancer cell dynamics

Benjamin Major, PhD
Assistant Professor
UNC School of Medicine
Department of Cell Biology and Physiology
Analysis of cancer protein changes

Recruitment and Retention by Year



Supporting Infrastructure and shared resources

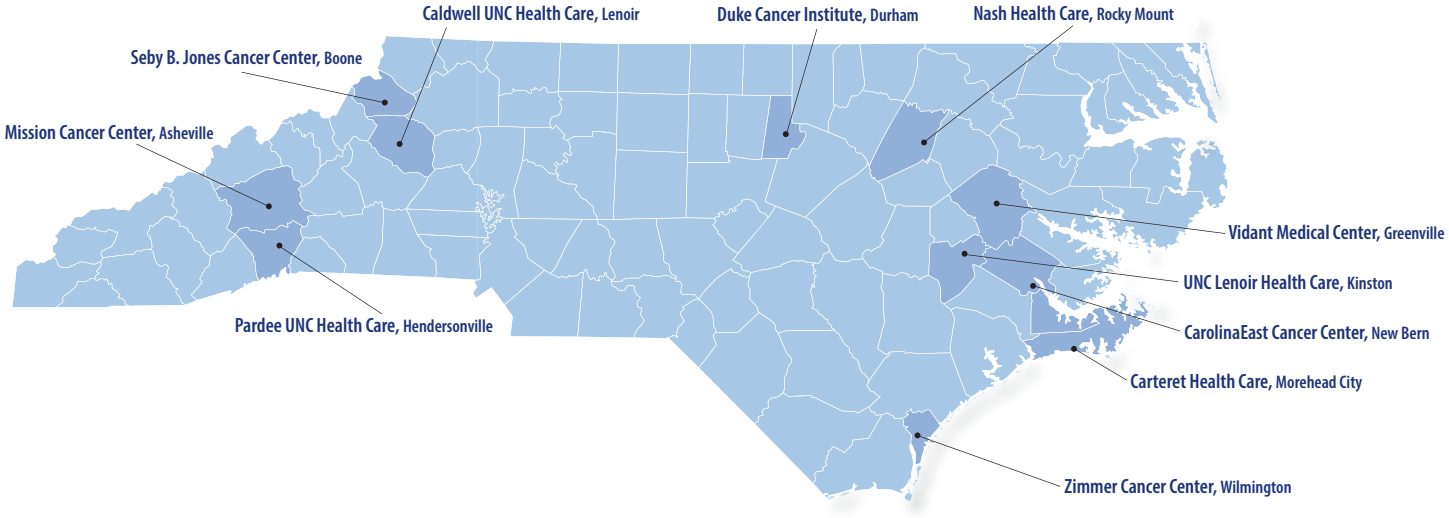
In addition to recruiting and retaining world-class researchers and clinicians, investments from the UCRF have supported vital core infrastructure and shared resources. Imaging, informatics and other research tools are critical in improving cancer research and care. The development of virtual tumor boards, telemedicine, community and provider partnerships, and other outreach initiatives have helped us reach patients and clinical practices in every North Carolina county. Our lay patient navigation program, created with UCRF funds, leveraged outside foundation funding to expand to 10 hospitals this year. Our cancer survivorship program is also expanding this year to reach more patients. We also are continuing to provide educational opportunities for medical professionals, including physicians, nurses, and technicians, from across the state. These are just a few examples of how the UCRF is helping us reach beyond the boundaries of Chapel Hill and have an impact throughout all of North Carolina.

Duke Endowment grant to help UNC roll out lay patient navigation program across N.C.

The Duke Endowment of Charlotte has awarded a three-year, $600,000 grant to UNC Lineberger to establish a multi-institutional lay patient navigation program aimed at improving cancer outcomes in North Carolina.

UNC Lineberger's **Thomas C. Shea, MD**, associate director for Outreach Programs at UNC Cancer Network, and **Jean Sellers, RN, MSN**, clinical administrative director at UNC Cancer Network, initiated implementation research on lay health navigators as a cost-effective way to improve cancer patient-centered care. They will use the funding to expand the UNC Lay Patient Navigation Program in 11 hospitals and cancer care facilities that collectively cover a wide geographic region of the state. They are:

- Caldwell UNC Health Care, Lenoir
- CarolinaEast Cancer Center, New Bern
- Carteret Health Care, Morehead City
- Duke Cancer Institute, Durham
- Mission Cancer Center, Asheville
- Nash Health Care, Rocky Mount
- Pardee Hospital, Hendersonville
- Seby B. Jones Cancer Center, Boone
- UNC Lenoir Health Care, Kinston
- Vidant Medical Center, Greenville
- Zimmer Cancer Center, Wilmington



Sellers, who has spent much of her 25-year oncology nursing career working with community and rural cancer centers, said there is a growing demand for cancer care and a shrinking workforce. As a result, providers are spending more time on acute care problems, leaving less time for non-clinical care such as emotional and social support or financial counseling.

In 2009, the UNC Cancer Network developed a training curriculum and model of patient navigation that paired volunteers with health care teams to address critical components of non-clinical support in eastern North Carolina. Although the patient navigator field is still developing – there currently are no national standards for lay patient navigator training programs – UNC Lineberger, with UCRF support, has developed a model that the Advisory Board, a national health care consulting firm, rates as one of three best practices of patient navigation in the United States.

"Despite advances in cancer detection, prevention and treatment, cancer still takes a terrible toll on the personal and community level," said Shea. "Each year, more than 56,000 cases of cancer are diagnosed in North Carolina. By making lay patient navigation programs more widely available across the state, we can help people receive better cancer care by alleviating the burden the disease places on so many."

Shea and Sellers expect the first program to be developed and operational this fall, and for all 10 programs to be in place by the end of 2018.

UNC Lineberger expands cancer survivors' program to more N.C. locations

UNC Lineberger's Comprehensive Cancer Support Program has expanded its program for cancer survivors in North Carolina.

The N.C. Cancer Survivorship Provider Action Network offers cancer survivors and their loved ones a free, four-week educational program on nutrition, exercise, coping with stress and medical care. The program seeks to engage survivors to smooth the transition from active treatment.

"During active treatment, you have appointments, you have scans, you are taking medicines, and there are a lot of people helping you with what to do and when to do it," said **Donald Rosenstein, MD**, director of the Comprehensive Cancer Support Program and founder of the network. "When some patients come to the end of their treatment, sometimes they feel a bit lost at sea, and wonder: What do I do next? We want to engage patients and caregivers to be more active participants in their survivorship; to be more knowledgeable, and more engaged."

The goal of the program is to provide direct survivorship care and build the capacity to deliver additional survivorship programs in the future. Program leaders have trained four cohorts of providers – including nurses, social workers, nutritionists, patient educators, and other health professionals – through workshops in Chapel Hill, as well as through video conferences.

"The hope is that by identifying and training this network of providers, if there are other types of interventions related to cancer survivorship that we might be able to roll out, we'll have an engaged workforce," Rosenstein said.

UNC Cancer Network educates medical professionals, patients

UNC has a critical role in providing continuing medical education (CME) to health care providers in North Carolina. Physicians earn CME credit from the American Medical Association by attending events sponsored by an accredited provider and use the credit toward re-licensure, re-certification, and renewal of hospital privileges.

The UNC Cancer Network is the primary UNC School of Medicine source of continuing education for oncology professionals.

The program offers live, interactive medical and nursing lectures delivered by UNC faculty as part of a bimonthly continuing education series for physicians, nurses and allied health professionals across North Carolina. This lecture series allows practitioners to access timely, evidence-based oncology therapeutic updates from the convenience of their own practice – and earn continuing education credits. Medical professionals earned 1,103 CME credit hours this year for lecture participation via the telehealth infrastructure.

UNC's tumor boards are another important source for continuing education. This year, tumor boards provided nearly 2,900 credit hours to North Carolina's oncology workforce in the following specialty areas:

Breast	966
Gastro-Intestinal	666
Head and Neck	547
Hematology-Oncology (Parker)	307
Pediatrics	407
Total	**2,893**

UCRF resources have significantly improved UNC's ability to connect with oncologists and cancer patients across North Carolina. Using the infrastructure supported by UCRF funds, UNC faculty regularly hold virtual "tumor boards" – in-depth review of a particular patient's case with a team of doctors – with doctors in hospitals across the state, and do consultations in specialties that are lacking in rural communities. This year nearly 140 virtual tumor boards helped connect community-based medical professionals with UNC oncology experts.

Through the telehealth network, UNC connects with health care providers in real time to discuss best practices for patient care and cutting-edge research, and holds community education events to raise patient awareness of issues related to cancer. This year, UNC hosted 40 lectures with almost 2,380 viewings of these broadcast events, reaching nurses, doctors, physician assistants, nurse practitioners, pharmacists, social workers, nutritionists and clinic managers in nearly 40 oncology practices across the state.

BUDGET AND EXPENDITURES

UNIVERSITY CANCER RESEARCH FUND
2017 LEGISLATIVE REPORT

UNC LINEBERGER

BUDGET AND EXPENDITURES

The UCRF was initially funded by three sources of support: tobacco settlement funds, taxes on other (non-cigarette) tobacco products (OTP) such as snuff, and state appropriations. In the 2013-2014 budget, the General Assembly consolidated all tobacco settlement funds into the State's General Fund. That consolidation eliminated tobacco settlement funds as a source of UCRF support. The OTP tax proceeds, the amount of which varies by year based on product sales, and the $16 million state appropriation have remained intact as UCRF revenue sources.

The charts below reflect anticipated and actual revenue for this year, and the fund balance after considering carryover and expenditures.

Anticipated and Actual Revenue

FY 16-17 Anticipated and Actual Fund Revenue	Amount*
Anticipated	
State Appropriation	$16,020,000
Projected OTP Tax Receipts	$30,280,000
Total	$46,300,000
Actual	
State Appropriation	$16,020,000
Tobacco Settlement Fund Transfer	--
Actual OTP Tax Receipts	$30,325,010
Total	$46,345,010
Balance	$45,010

Fund Balance

FY 15-16 Budget and Expenditures	Amount*
Anticipated Budget	
Revenue	$46,300,000
Carryover from FY 2016	-$225,188
Carryover from unrealized FY 2016 OTP tax receipts	--
Total	$46,074,812
Actual Budget	
Revenue	$46,345,010
Carryover from FY 2016	-$225,188
Carryover from unrealized FY 2016 OTP tax	--
Total	$46,119,822
Expenditures	$46,356,195
Balance	-$236,373

* Rounded to the nearest dollar

Restrictions on the Use of UCRF Monies

G.S. 116 29.1 established the Fund as a special revenue fund and created the Cancer Research Fund Committee to provide accountability. As the Cancer Research Fund Committee, led by its Chairman, then-UNC President Erskine Bowles, developed the UCRF Strategic Plan in 2009, each potential use of UCRF resources was evaluated according to the following questions:

- Will it address North Carolina's needs in terms of the goal of reducing the cancer burden in the state?
- Can we be world class at it? (Does it build on existing strengths, and is there an opportunity to lead?)
- Is there a strong economic model/justification for UCRF investment?

Based on these questions, the Committee developed a clear set of rules to guide how UCRF funds would be best spent. The Committee determined that UCRF funds should focus major resources on a limited set of opportunities to have the greatest impact; fund initiatives where UNC has the opportunity to establish a leadership position; be self-sustaining and provide leverage for additional extramural funding; build fundamental cancer-related research capabilities that benefit UNC research programs; and enhance North Carolina's economy by creating jobs, intellectual property, and startup companies.

To maximize the effectiveness of the state's investment and to ensure wise and responsible use of the funding, the Strategic Plan imposed additional restrictions on the use of these funds, instructing that UCRF funds *should not:*

- Invest broadly in an effort to make incremental improvements everywhere;
- Provide funding that would limit future flexibility;
- Undermine faculty innovation and competitiveness by eliminating the need for extramural grant funding;
- Substitute for existing university or health system funding or new philanthropy;
- Make expenditures based upon institutional or other needs outside cancer research; or
- Negatively impact other research on campus, for example by appropriating shared research infrastructure or resources.

Conclusion

The UCRF is invested responsibly, strategically and effectively to power innovative research that will enhance the prevention, diagnosis and treatment of cancer and improve outcomes for patients. It has enabled us to form important partnerships and share research resources with other universities, the private sector, and with communities all across our state. The UCRF leverages remarkable amounts

Expenditures of State Funds related to UCRF

The table below provides an accounting of expenditures of state funding related to the UCRF. Further details regarding these expenditures are included as appendices to this report.

More than half the funding from UCRF has been used to recruit world-class researchers to North Carolina. Less than 2 percent of the total UCRF budget is used for ongoing administrative expenses.

Categories	YTD Actual*
Strategic Plan Categories	
Tier 1: Research Priorities	
Understanding Genetics	6,374,372
Developing Novel Therapies	7,767,702
Optimizing Outcomes	7,548,459
Tier 2: Opportunity Fund	10,340,325
Tier 3: Critical Infrastructure	
Clinical Excellence – Research & Outreach	6,278,886
Research & Tech Development and Training	8,046,451
Total	**46,356,195**

* Rounded to the nearest dollar

of external funding, and has sparked jobs and commercialization opportunities for North Carolina. Its total economic impact demonstrates a 9-to-1 return on investment in FY 201.

The UCRF's economic benefits to our state continue to grow, and our progress in cancer care and research will have a lasting impact both in and beyond our state. We are sincerely grateful for the General Assembly's continued support of the University Cancer Research Fund – it is a vital tool in our ongoing efforts to defeat our state's deadliest disease.

APPENDIX

UNIVERSITY CANCER RESEARCH FUND
2017 LEGISLATIVE REPORT

UNC LINEBERGER

APPENDIX

ESTABLISHING LEGISLATION

ESTABLISHING LEGISLATION

§ 116-29.1. University Cancer Research Fund (as modified by SL 2013-360)

a. **Fund.** – The University Cancer Research Fund is established as a special revenue fund in the Office of the President of The University of North Carolina. Allocations from the fund shall be made in the discretion of the Cancer Research Fund Committee and shall be used only for the purpose of cancer research under UNC Hospitals, the Lineberger Comprehensive Cancer Center, or both.

b. Effective July 1 of each calendar year, the funds remitted to the University Cancer Research Fund by the Secretary of Revenue from the tax on tobacco products other than cigarettes pursuant to G.S. 105-113.40A is appropriated for this purpose are appropriated for this purpose.

c. **Cancer Research Fund Committee.** – The Cancer Research Fund Committee shall consist of five ex officio members and two appointed members. The five ex officio members shall consist of the following: (i) one member shall be the Chancellor of the University of North Carolina at Chapel Hill, (ii) one member shall be the Director of the Lineberger Comprehensive Cancer Center, (iii) one member shall be the Dean of the School of Medicine at The University of North Carolina, (iv) one member shall be the Dean of the School of Pharmacy at The University of North Carolina, and (v) one member shall be the Dean of the School of Public Health at The University of North Carolina. The remaining two members shall be appointed by a majority vote of the standing members of the Committee and shall be selected from persons holding a leadership position in a nationally prominent cancer program. If any of the specified positions cease to exist, then the successor position shall be deemed to be substituted in the place of the former one, and the person holding the successor position shall become an ex officio member of the Committee.

d. **Chair.** – The chair shall be the Chancellor of the University of North Carolina at Chapel Hill.

e. **Quorum.** – A majority of the members shall constitute a quorum for the transaction of business. A

f. **Meetings.** – The Committee shall meet at least once in each quarter and may hold special meetings at any time and place at the call of the chair or upon the written request of at least a majority of its members. (2007-323, s. 6.23(b); 2009-451, s. 27A.5(e); 2010-31, s. 9.12.)

g. **Report.** – By November 1 of each year, the Cancer Research Fund Committee shall provide to the Joint Legislative Education Oversight Committee and to the Office of State Budget and Management an annual financial report which shall include the following components:

   1. Accounting of expenditures of State funds related to strategic initiatives, development of infrastructure, and ongoing administrative functions.
   2. Accounting of expenditures of extramural funds related to strategic initiatives, development of infrastructure, and ongoing administrative functions.
   3. Measures of impact to the State's economy in the creation of jobs, intellectual property, and start-up companies.
   4. Other performance measures directly related to the investment of State funds.
   5. Accounting of any fund balances retained by the Fund, along with information about any restrictions on the use of these funds.

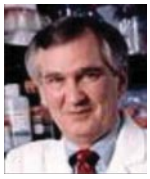
APPENDIX

CANCER RESEARCH FUND COMMITTEE

CANCER RESEARCH FUND COMMITTEE

The legislatively established Cancer Research Fund Committee, chaired by Carol Folt, Chancellor of the University of North Carolina at Chapel Hill, oversees the University Cancer Research Fund. The seven-member committee includes five ex-officio members designated by the legislation who elect two at-large members. The at-large members are to be leaders at nationally prominent cancer programs. Currently, the two are Edward Benz, MD, (President and CEO Emeritus, Dana-Farber Cancer Institute) and Gary Gilliland, MD, PhD, (President and Director, Fred Hutchinson Cancer Research Center).

Carol Folt, PhD, Chair
Chancellor
The University of North Carolina at Chapel Hill



Edward J. Benz, MD
President and Chief
Executive Officer, Emeritus
Dana-Farber Cancer Institute

Robert Blouin, PharmD
Dean
UNC Eshelman School of Pharmacy
The University of North Carolina at Chapel Hill

Gary Gilliland, MD, PhD
President and Director
Fred Hutchinson Cancer Research Center

Barbara K. Rimer, DrPH
Dean
Gillings School of Global Public Health
The University of North Carolina at Chapel Hill

William L. Roper, MD, MPH
Dean
UNC School of Medicine
Vice Chancellor for Medical Affairs
CEO, UNC Health Care
The University of North Carolina at Chapel Hill

Norman E. Sharpless, MD
Director
UNC Lineberger Comprehensive Cancer Center
The University of North Carolina at Chapel Hill

APPENDIX

FY 16-17 EXPENDITURES

UNC LINEBERGER

UCRF Fiscal Year 2017

Strategy	Sum of Annual Budget	Sum of Year to Date Actual*	Sum of Cash Balance
Theme 1: Optimizing NC Cancer Outcomes	$6,300,000	$6,374,372	-$74,372
Theme 2: Understanding Genetics in Cancer – Basic Approaches & Clinical Applications	$7,600,000	$7,767,702	-$167,702
Theme 3: Develop New Cancer Treatments	$7,800,000	$7,548,459	$251,541
Tier 2: Opportunity Fund**	$10,145,000	$10,340,325	-$195,325
Tier 3: Infrastructure - Clinical Excellence and	$6,750,000	$6,278,886	$471,114
Outreach Infrastructure	$7,750,010	$8,046,451	-$296,441
Grand Total	**$46,345,010**	**$46,356,195**	**-$11,185**

* Rounded to the nearest dollar

Expenditures for Fiscal Year 2017

Objective	Year To Date Actual*	Expense to Total Expenditure
Faculty Salaries	$14,432,365	31.1%
EPA Student Salaries	$2,687,729	5.8%
Staff Salaries	$6,896,582	14.9%
Other Staff	$294,087	0.6%
Bonus Incentive Wages	$172,054	0.4%
Benefits	$6,201,542	13.4%
HCS Contracted Serv	$531,776	1.1%
Phy Benefits	$192,021	0.4%
Other Staff Benefits	$131,180	0.3%
Transit Tax	$72,875	0.2%
Consultants/Contracted Services	$486,270	1.0%
Employee Education	$20,761	0.0%
Repairs and Maint	$2,100,735	4.5%
Other Current Services	$2,029,839	4.4%
Supplies, Other	$3,496,938	7.5%
Travel	$455,599	1.0%
Freight and Exp	$0	0.0%
Maintenance Contracts	$1,766,607	3.8%
Advertising	$8,564	0.0%
Meetings & Amenities	$21,776	0.0%
Transfer Computer Science	$0	0.0%
Printing and Binding	$39,721	0.1%
Communication	$187,231	0.4%
Contracted Serv	$0	0.0%
Computer Services	$210,828	0.5%
Rental/Lease Facilities	$816,307	1.8%
Other Fixed Charges	$0	0.0%
Rental Equipment	$0	0.0%
Equipment	$1,860,937	4.0%
Study Subjects & Exp	$123,677	0.3%
Employee on Loan	$0	0.0%
Insurance	$4,069	0.0%
Student Support	$917,171	2.0%
HCS Residents	$120,237	0.3%
Utilities	$67,063	0.1%
Legal Fees	$9,655	0.0%
HIPAA Deduct	$0	0.0%
Grand Total	**$46,356,195**	**100.0%**

* Rounded to the nearest dollar

Theme 1: Optimizing NC Cancer Outcomes

Objective	Year To Date Actual*
Faculty Salaries	$2,417,273
EPA Student Salaries	$169,501
Staff Salaries	$1,258,730
Other staff	$127,309
Bonus Incentive Wages	$33,889
Benefits	$1,081,509
Phy Benefits	$1,689
Other Staff Benefits	$21,538
Transit Tax	$11,962
Consultants/Contracted Services	$58,410
Employee Education	$4,125
Repairs and Maint	$24,250
Other Current Services	$78,335
Supplies, Other	$95,727
Travel	$126,629
Legal Fees	$4,960
Maintenance Contracts	$78,435
Advertising	$0
Meetings & Amenities	$897
Printing and Binding	$11,488
Communication	$59,896
Contracted Serv	$0
Computer Services	$167,665
Rental/Lease Facilities	$308,775
Other Fixed Charges	$0
Equipment	$15,226
Insurance	$43
Study Subjects & Exp	$107,199
Student Support	$108,911
Equip Rental	$0
HCS Residents	$0
Theme 1 Total	**$6,374,372**

* Rounded to the nearest dollar

Theme 2: Understanding Genetics in Cancer - Basic Approaches & Clinical Applications

Objective	Year To Date Actual*
Faculty Salaries	$2,034,472
EPA Student Salaries	$124,949
Staff Salaries	$1,539,235
Other staff	$66,738
Bonus Incentive Wages	$31,187
Benefits	$1,086,928
HCS Contracted Serv	$0
Phy Benefits	$14,178
Other Staff Benefits	$20,193
Transit Tax	$11,218
Consultants/Contracted Services	$118,652
Employee Education	$2,037
Repairs and Maint	$15,252
Other Current Services	$551,458
Supplies, Other	$817,016
Travel	$67,003
Maintenance Contracts	$443,170
Advertising	$0
Meetings & Amenities	$34
Printing and Binding	$6,778
Communication	$29,437
Computer Services	$42,219
Rental/Lease Facilities	$207,697
Other Fixed Charges	$0
Equipment	$441,744
Insurance	$0
Study Subjects & Exp	$437
Student Support	$32,469
Utilities	$63,201
Theme 2 Total	**$7,767,702**

* Rounded to the nearest dollar

Theme 3: Developing New Cancer Treatment

Objective	Year To Date Actual*
Faculty Salaries	$2,723,306
EPA Student Salaries	$466,410
Staff Salaries	$706,714
Other staff	$56,649
Bonus Incentive Wages	$26,602
Benefits	$966,417
Phy Benefits	$6,717
Other Staff Benefits	$20,837
Transit Tax	$11,576
Consultants/Contracted Services	$73,689
Employee Education	$2,149
Repairs and Maint	$24,323
Other Current Services	$532,132
Supplies, Other	$645,847
Travel	$24,736
Maintenance Contracts	$500,842
Advertising	$0
Meetings & Amenities	$0
Transfer Computer Science	$0
Printing and Binding	$5,219
Communication	$34,539
Computer Services	$40
Rental/Lease Facilities	$281,712
Other Fixed Charges	$0
Rental Equipment	$0
Equipment	$364,198
Employee on Loan	$0
Insurance	$0
Student Support	$73,806
Legal Fees	$0
Theme 3 Total	**$7,548,459**

* Rounded to the nearest dollar

Tier 2: Opportunity Fund

Objective	Year To Date Actual*
Faculty Salaries	$1,618,224
EPA Student Salaries	$996,902
Staff Salaries	$783,514
Other staff	$110,644
Bonus Incentive Wages	$19,395
Benefits	$844,820
HCS Contracted Serv	$28,498
Phy Benefits	$12,358
Other Staff Benefits	$18,817
Transit Tax	$10,454
Consultants/Contracted Services	$75,734
Employee Education	$2,702
Repairs and Maint	$2,033,609
Other Current Services	$731,640
Supplies, Other	$1,580,452
Travel	$179,265
Maintenance Contracts	$249,013
Advertising	$0
Meetings & Amenities	$2,211
Printing and Binding	$12,920
Communication	$44,420
Computer Services	$0
Other Fixed Charges	$0
Rental/Lease Facilities	$15,872
Equipment	$761,305
Legal Fees	$4,695
Insurance	$4,026
Study Subjects & Exp	$14,664
Student Support	$184,173
Utilities	$0
HCS Residents	$0
Tier 2 Total	**$10,340,325**

* Rounded to the nearest dollar

Tier 3: Infrastructure - Clinical Excellence and Outreach

Objective	Year To Date Actual*
Faculty Salaries	$3,967,927
EPA Student Salaries	$12,322
Staff Salaries	$388,028
Other Staff	$18,310
Bonus Incentive Wages	$22,467
Benefits	$926,566
HCS Contracted Serv	$503,278
Phy Benefits	$155,174
Other Staff Benefits	$23,783
Transit Tax	$13,213
Consultants/Contracted Services	$9,842
Employee Education	$8,608
Repairs and Maint	$172
Other Current Services	$43,075
Supplies, Other	$34,747
Travel	$10,897
Maintenance Contracts	$4,550
Advertising	$0
Meetings & Amenities	$0
Printing and Binding	$3,315
Communication	$7,293
Contracted Serv	$0
Computer Services	$729
Rental/Lease Facilities	$0
Other Fixed Charges	$0
Equipment	$0
Insurance	$0
Study Subjects & Exp	$1,378
Employee on Loan	$0
Student Support	$2,976
Rental Equipment	$0
HCS Residents	$120,237
Tier 3 Total	**$6,278,886**

* Rounded to the nearest dollar

Infrastructure

Objective	Year To Date Actual*
Faculty Salaries	$1,671,163
EPA Student Salaries	$917,645
Staff Salaries	$2,220,361
Other Staff	-$85,563
Bonus Incentive Wages	$38,514
Benefits	$1,295,303
HCS Contracted Serv	$0
Phy Benefits	$1,904
Other Staff Benefits	$26,014
Transit Tax	$14,452
Consultants/Contracted Services	$149,943
Employee Education	$1,140
Repairs and Maint	$3,130
Other Current Services	$93,198
Supplies, Other	$323,149
Travel	$47,070
Freight and Exp	$0
Maintenance Contracts	$490,596
Advertising	$8,564
Meetings & Amentites	$18,635
Printing and Binding	$0
Communication	$11,646
Contracted Serv	$0
Computer Services	$175
Rental/Lease Facilities	$2,251
Other Fixed Charges	$0
Equipment	$278,464
Insurance	$0
Legal Fees	$0
Study Subjects & Exp	$0
Employee on Loan	$0
Student Support	$514,837
Utilities	$3,862
Infrastructure Total	**$8,046,451**
GRAND TOTAL	$46,356,195

* Rounded to the nearest dollar

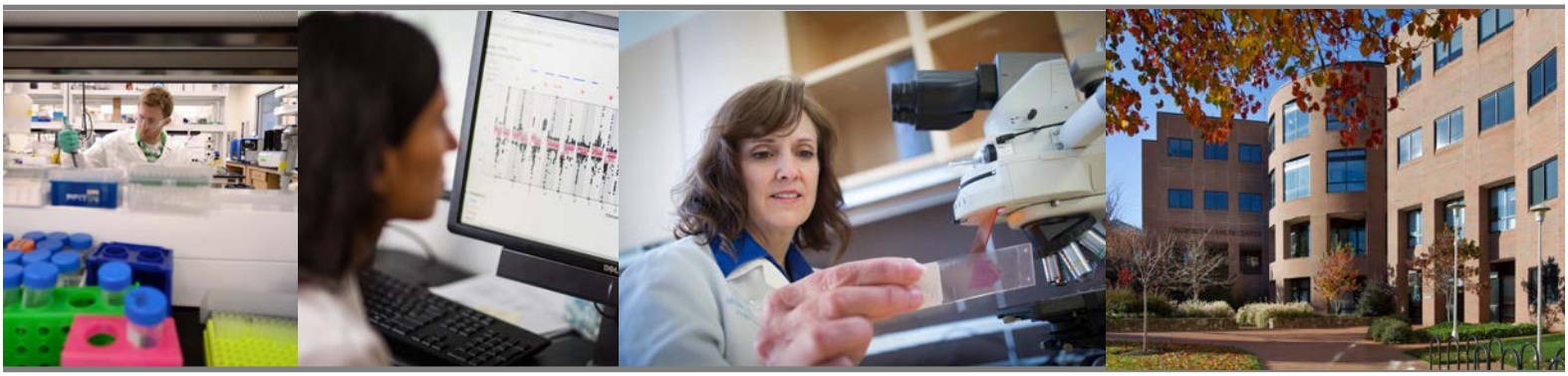
APPENDIX

ECONOMIC IMPACT ANALYSIS

UNC
LINEBERGER

The Economic Impact of University Cancer Research Fund

Current economic, employment, government revenue, and generated research funds which assist with the recruiting and retaining of local research talent due to the UCRF at University of North Carolina Lineberger Comprehensive Cancer Center



October 2017

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Table of Contents

Executive Summary

In 2007, the state leaders of North Carolina developed a fund to invest in cancer research in the state. Cancer is one of the leading causes of death in North Carolina, and the fund was developed to demonstrate a commitment to the health of the state residents. Although cancer mortality rates have been decreasing, incident rates of cancer have been increasing over the past decade.[1] Additionally, lung cancer continues to be the leading cancer causing death in North Carolina.[2]The state is investing in this fund, ensuring that future generations of North Carolinians will develop cancer less often, and live longer and better when they do.

The initial investment in 2007 to the University Cancer Research Fund (UCRF) of $25 million has grown to $46 million for FY 2017. This year alone the FY 2017 $46 million investment produced an economic impact of more than $419.7 million. This investment has translated into innovative research to detect, treat, and prevent cancer and has given an opportunity for UNC to become home to one of the nation's leading public comprehensive cancer centers. University of North Carolina Lineberger Comprehensive Cancer Center (UNC LCCC) is one of only 49 NCI-designated comprehensive cancer centers. The center brings together some of the most exceptional physicians and scientists in the country to investigate and improve the prevention, early detection, and treatment of cancer. With research that spans the spectrum from the laboratory to the bedside to the community, the faculty work to understand the causes of cancer at the genetic and environmental levels, to conduct groundbreaking laboratory research, and to translate findings into pioneering and innovative clinical trials. Investment in the UCRF allows the state an even greater ability to continue its tradition of care for all North Carolinians. It is an investment in making the best care in the world available in North Carolina; and it is difficult to think of a better investment than one for the future health of the state.

People and place are the keys to the UCRF's success. UCRF is about investing in people – promising researchers with the best ideas for cancer research and master clinicians who know how to bring those findings to patients and others. UNC Chapel Hill and its UNC Lineberger Comprehensive Cancer Center have a culture of collaboration – both across the University and with partners beyond the University's walls – that is essential to promote discovery and then turn those discoveries into new ways to treat, find, and prevent cancer. Outside of the obvious impacts this National Cancer Institute-designated Comprehensive Cancer Center provides to North Carolina, there are additional impacts that the UCRF provides to the state through the dollars that directly and indirectly impact the state economy and job numbers.

[1] Cancer in North Carolina 2013 Report. North Carolina State Center for Health Statistics.

[2] Cancer Profiles North Carolina April 2017 http://www.schs.state.nc.us/schs/CCR/cp2017/NorthCarolina.pdf

The aim of this report is to illustrate in detail the positive economic impact that UCRF dollars have on North Carolina's biomedical sector in the current year as well as the history of impacts the fund has shown over the last decade; it is important to note that these impacts have been annual since the Fund's inception. Through expanding the state economy, creating jobs, generating tax revenue, encouraging scientific collaboration, and leveraging federal research funds, these dollars have provided a significant benefit to the State of North Carolina.

University Cancer Research Fund

Key Findings

- **Expanding the state's economy.** UCRF generated nearly more than $419.7 million in total economic impact in North Carolina in 2017. This includes direct spending of more than $224.2 million within the state, much of which is a result of the generation of funds from national grants due to research activities which is just a portion of the $177.8 million in research funding received in 2017 alone. The ripple effect of in-state spending accounts for nearly $195.5 million additional dollars; representing downstream spending by employees, vendors, and contractors. This is just the impact of the current year (2017). Tripp Umbach estimates that through the commercialization of the discoveries made from this research, the impact by 2027 will be dramatically larger.

- **Creating jobs.** UCRF directly supported employment in 2017 of more than 1,096 jobs in North Carolina and an additional 1,506 jobs through both the indirect and induced impacts of those direct jobs and the spending generated from the UCRF within North Carolina. This means the total impact of this fund is more than 2,602 jobs.

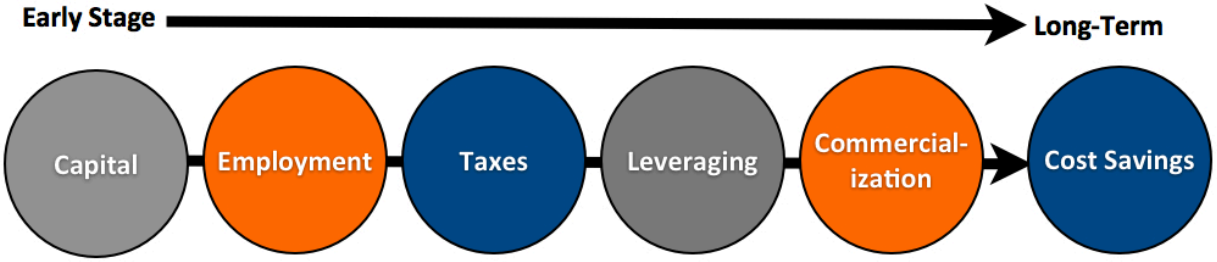
- **Generating tax revenue.** Tripp Umbach estimates that UCRF provided nearly $14.5 million in local and state tax revenue in 2017.

- **Encouraging scientific collaboration and leveraging federal research funds.** These funds have encouraged recipient institutions to collaborate, as well as to apply for and win, highly competitive federal grants. Recipients of these state research funds have leveraged federal research funds which have amounted to more than $137.7 million in federal research grants, bringing the total to over $177.8 million in external funding in 2017 alone. This would not have been possible without the UCRF funding, which elevated the UNC Lineberger Comprehensive Cancer Center to the top rankings.

Impacts of UCRF in 2017

Any discussion of the economic impact of these state funds must be predicated on an understanding that research investments, by their nature, have a multitude of impacts on a state's economy, both in the present and in the future. Short-term impacts include capital and non-capital investment and employment growth supported by the funds and new federal medical research funding leveraged by North Carolina's funds that expand the state's economy. Longer term impacts include a strengthened ability to compete nationally for funding and to attract world-class scientists; the economic and employment advances that will be achieved when medical research and innovation are translated into commercial products and services; and healthcare cost-savings to the state as a result of innovation (see Figure 1):

Figure 1: Research Return on Investment Timeline

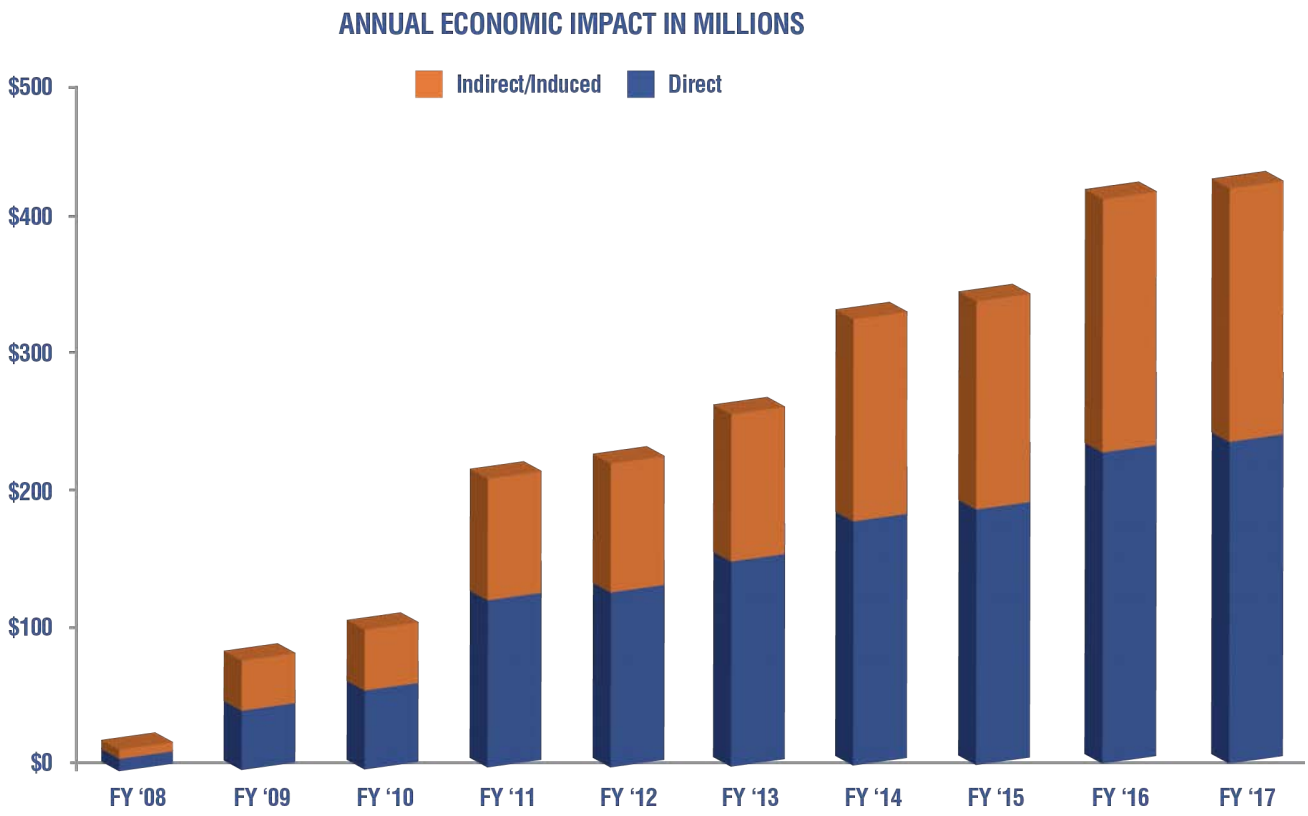


Early Stage Economic Impact of Funding

UCRF dollars invested in research in 2017 have resulted in an expansion of the state's economy by nearly $419.7 million. Tripp Umbach's economic impact analysis indicates that even in the early stage (2007-2011), program investments in capital and human resources have returned greater than three dollars to the state's economy for every one dollar invested. In 2017, this amount has risen to more than nine dollars for every dollar invested. Spending attributable to the fund can be divided into two parts: direct and indirect/ induced impacts.

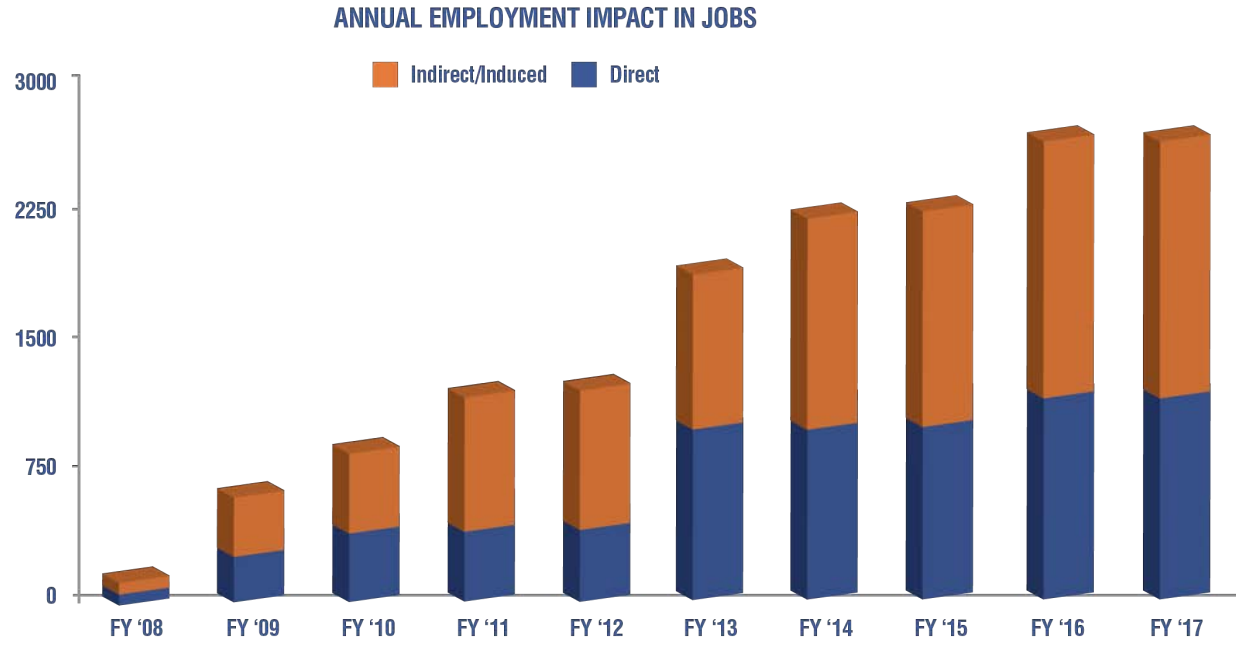
The direct impacts of program funding include institutional expenditures for capital improvements, goods and services, as well as the spending by researchers, research staff, subcontractors, and visitors who come to these institutions for conferences and meetings. The indirect impacts of tobacco funds result from these direct, first-round expenditures, which are received as income by businesses and individuals in the state and re-circulate through the economy in successive rounds of re-spending. The end result is a multiplied economic impact that

is a linear result of the state's investment in research. The impacts over the last decade are outlined below in the chart below.



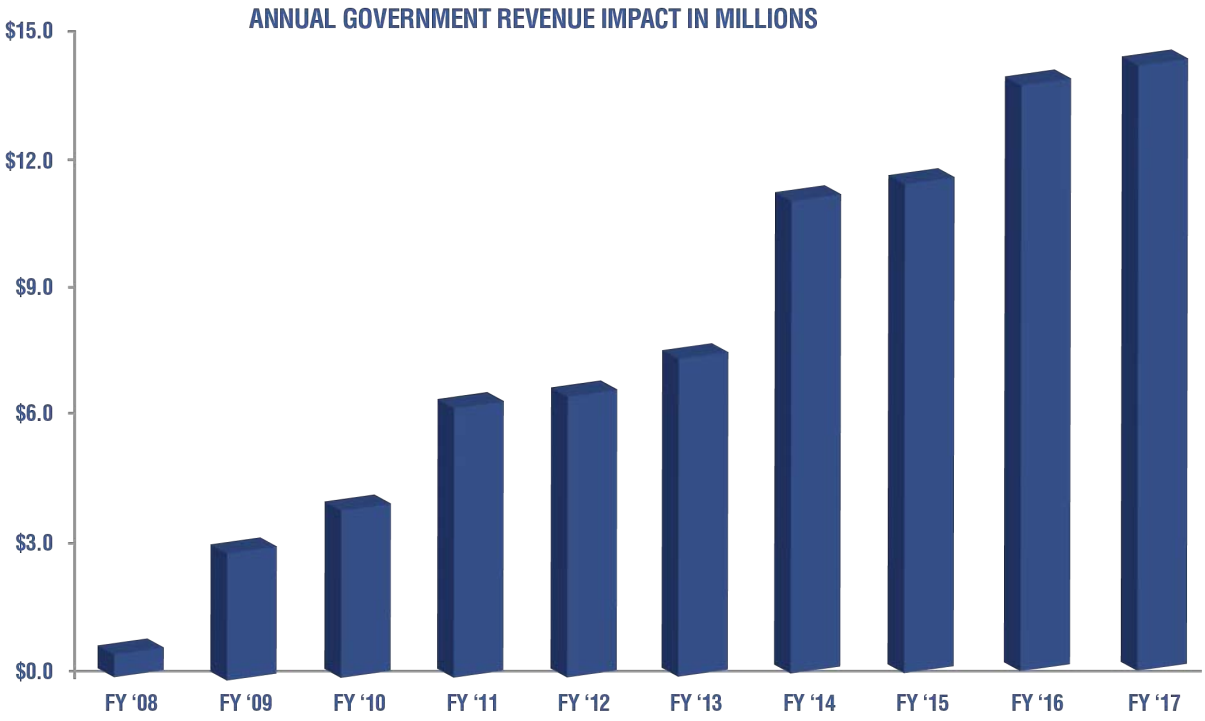
Early Stage Impact of UCRF Dollars on Employment

Tripp Umbach estimates that in 2017, UCRF dollars for healthcare research have created and sustained 2,602 high-paying research-related jobs throughout the state of North Carolina. This includes both the 1,096 high-paying research-related jobs directly attributed to UNC in addition to the 1,506 indirect and induced jobs supported throughout the state of North Carolina. The economic expansion created by the funds allocated to the UCRF have, in turn, brought about demand for additional employment in the state's economy. The employment impact has continued to grow and provide high paying jobs to the state of North Carolina.



Early and Later Stage State Tax Impacts

Tripp Umbach estimates that funds provided in 2017 have resulted in nearly $14.5 million in tax revenues to the state of North Carolina. In-state spending by the recipient organizations and spending in the state by out-of-state parties have a significant impact on state tax revenue. Taxes created as a result of spending in the state's economy, and generation of fresh dollars from outside of the state, are expected to grow as early-stage research is commercialized. The tax impacts have increased over the last decade as well providing a return to the state for the investment.



Impacts Associated with Leveraged Federal Medical Research Funds

The North Carolina academic medical industry and growing life sciences industry have been measurably enhanced by these state funds. This federal medical research funding helps fuel clinical enterprises. According to the Association of American Medical Colleges, North Carolina's academic medical industry is among the top 10 nationally in total annual economic impact[3].

These funds from the states UCRF have encouraged researchers at the recipient organization to collaborate to apply for and win highly competitive federal grants. These funds have enabled

[3] In 2012, North Carolina ranked 10th in Academic Medical Impact of AAMC members and COTH hospitals.

recipients of UCRF dollars to leverage federal research funds which have amounted to more than $137.7 million, bringing the total to over $177.8 million in external funding in 2017 alone.

Healthcare Cost-Savings

While this study does not include detailed economic impact models that calculate the potential cost-savings attributable to research activities, a growing body of literature provides some potential insights. Breakthrough research by Silverstein et al. (1995) documented $69 billion in annual economic savings resulted from NIH-supported research. The return on investment calculated by Silverstein was $7 in healthcare cost-savings for every dollar invested in NIH-sponsored research[4].

Commercialization

Additional impacts which will be realized due to the UCRF are the levels of commercialization that occur when clusters of research professionals collaborate on a specialty area of research. Tripp Umbach estimates that after ten years of funding and operations, the commercialization of the UCRF will produce discoveries and spinoff businesses which will generate additional economic activity in the State of North Carolina. Looking at projected commercialization impact in 2027, Tripp Umbach estimates this to be between $340.7 million at a conservative level of growth scenario and $750.1 million using the aggressive level of growth, in additional economic activity within North Carolina. These activities will also create between an additional 2,303 high paying jobs (conservative) and 5,071 jobs (aggressive). These additional economic and employment impacts will translate into additional state and local government revenue of between $11.4 million and $23.7 million.

It is important to note that these commercialization impacts are in addition to the annual operational impacts of the UCRF and that these impacts will continue to grow as the research fund continues to be successful. These are impacts that are realized after years of research once the breakthroughs or discoveries have been made and the discoveries begin to hit the marketplace. Examples of successful spinoff businesses supported by the UNC Lineberger include G1 Therapeutics, Genecentric, Epicypher,Epizyme, Liquidia, and many others. Since 2009, Lineberger startup companies have raised more than $300 million in non-dilutive financing from the NIH, angel investors and venture capitalists.

[4] Cost-Savings Resulting from NIH Research Support, NIH Publication No. 93. Silverstein, H.H. Garrison and S.J. Heinig, 1995.

Tripp Umbach's projections are based on 2017 funding, and the national experience of peer academic medical centers that have implemented similar academic, clinical, research, and economic development plans over the past 20 years. Since 1995, Tripp Umbach has measured the economic impact of every U.S. academic medical center on behalf of the Association of American Medical Colleges (AAMC) and used historical trending data from this experience in making projections.

Appendix A: Definition of Terms

Study Year

Fiscal Year 2017

Total Impact

The total impact of an organization is a compilation of the direct impact, the indirect impact, and the induced impact generated in the economy as a result of the organization.

Direct Impact

Direct impact includes all direct effects the organization has on the regional area due to the organizational operations. These items include direct employees, organizational spending, employee spending, as well as spending by patients and visitors to the organization.

Indirect Impact

The indirect impact includes the impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to value added. The impacts are calculated by applying direct effects to the Type I Multipliers.

Induced Impact

The response by an economy to an initial change (direct effect) that occurs through re-spending of income received by a component of value added. IMPLAN's default multiplier recognizes that labor income (employee compensation and proprietor income components of value added) is not leakage to the regional economy. This money is recirculated through the household spending patterns causing further local economic activity.

Multiplier Effect

The multiplier effect is the additional economic impact created as a result of the organization's direct economic impact. Local companies that provide goods and services to an organization increase their purchasing by creating a multiplier.

Appendix B: Methodology

In order to fully quantify the impact of the funding of UCRF to the operations of UNC Lineberger Comprehensive Cancer Center within the various geographical areas throughout this study, it was necessary for Tripp Umbach to establish a study methodology. It was critically important that the methodology used would deliver a comprehensive, yet conservative, estimate of the operations' impact, based on information compiled using uniform and consistent techniques. In addition, the study team sought to develop a reproducible methodology, ensuring that subsequent studies could build upon the information and knowledge gained through this effort.

Tripp Umbach determined that the use of the IMPLAN Pro economic impact model software was most appropriate for this analysis. The IMPLAN econometric model operates by estimating the direct impact, indirect impacts, and induced impacts of specific economic activity. Direct economic impacts are those attributable to the initial economic activity. For example, an operation with 10 full-time employees creates 10 direct jobs. Indirect economic impacts are those economic activities undertaken by vendors and suppliers within the supply chain of the direct activity because of the initial economic activity. For example, suppliers of goods, materials, and services used in the direct activities produce indirect economic impacts. Induced economic impacts result from the spending of wages paid to employees in local industries involved in direct and indirect activities. Tripp Umbach selected the IMPLAN model due to its frequent use in economic impact, in addition to its development independent of local influences.

Tripp Umbach collected employment information concerning the economic activity of UCRF's funding on operations themselves and followed up in-person to make certain the data was the most current available.

In this report, the impact was measured using IMPLAN datasets. The IMPLAN data files include information for 528 different industries (generally three- or four-digit SIC code breakdown) and 21 different economic variables. IMPLAN sources their employment data from ES202 employment security data supplemented by county business patterns and REIS data. Employment data utilized in the analysis includes full-time and part-time positions.

It should be noted that, at the time of performing the UCRF assessment, the most recent IMPLAN data files for the state of North Carolina were for 2015. While the data is not current, it is unlikely that the fundamental economic structure of North Carolina's economic fabric has changed to an extent that would invalidate the analysis. IMPLAN data and accounts closely follow the accounting

conventions used in the "Input/ Output Study of the U.S. Economy" by the U.S. Bureau of Economic Analysis and the rectangular format recommended by the United Nations.

By deriving the direct and actual employment numbers from IMPLAN for each county, Tripp Umbach was able to conduct input/output modeling to analyze the current impact of the industry in each county. Tripp Umbach supplied additional information as required to supplement the data supplied by UNC Lineberger Comprehensive Cancer Center.

Appendix C: Tripp Umbach Qualifications

Tripp Umbach is the national leader in providing economic impact analysis to leading healthcare organizations and academic health centers. The firm has completed more than 250 economic impact studies over the years for clients such as the Mayo Clinic Rochester, The Cleveland Clinic, University of Florida Shands HealthCare, and the Ohio State University Medical Center. In addition to work on multiple occasions for the six allopathic medical schools and academic medical centers in Pennsylvania, Tripp Umbach has completed statewide studies for multiple institutions in Ohio, Virginia, South Carolina, Wisconsin, and Minnesota.

Tripp Umbach recently completed its fifth national study of all U.S. medical schools and teaching hospital affiliates for the Association of American Medical Colleges.

Tripp Umbach has also completed economic impact studies for cancer centers such as the CURE Funding for PA Cancer Alliance, The Wistar Institute, University of North Carolina's Cancer Hospital, Ohio State University's James Cancer Center and Solove Research Center, Ohio State University's Comprehensive Cancer Center, Milton S. Hershey Medical Center's Cancer Institute, Mayo Clinic/Allegheny General Hospital Cancer Services planning, UPMC Hillman Cancer Center feasibility and economic impact projections study, University of Pennsylvania projected economic impact of the Cancer Center as a component of the Civic Center project, and University of Florida Shands Healthcare economic impact projections.

For more information on Tripp Umbach please go to www.trippumbach.com, for more information on this research please contact:

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Tripp Umbach

APPENDIX

LIST OF ACTIVE EXTRAMURAL AWARDS

UNC
LINEBERGER

UCRF	PI First Name	PI Last Name	Sponsor	Number	Begin	End	Title	Total Cost $
Retention	Nancy	Allbritton	NIH National Cancer Institute	5-F31-CA192529-02	4/1/15	3/31/18	FELLOW:WOSS, GREG Development and Optimization of an Analytical Chemical Separations Technique to Analyze E3 Ligase Activity in Single Cells	$32,938
Retention	Nancy	Allbritton	NIH National Cancer Institute	5-F31-CA206233-02	6/1/16	5/31/19	FELLOW:M DISALVO High-Throughput Generation of Pancreatic Organoids with Controlled Stromal Milieus using Microraft-Based Cell Sorting	$32,938
Retention	Nancy	Allbritton	NIH National Cancer Institute	5-R01-CA177993-01-03	8/15/14	7/31/19	Single-Cell Measurement of Lipid Signaling in Colorectal Cancer	$590,158
Retention	Nancy	Allbritton	NIH National Eye Institute	5-R01-EY024556-01-03	9/1/14	8/31/19	Generation of a Gene-Targeted Human iPS Cell Library for Macular Degeneration	$575,997
Retention	Nancy	Allbritton	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-R01-DK109559-01-02	9/25/15	7/31/20	Development of Human Intestinal Simulacra	$818,619
Recruitment	Antonio	Amelio	NIH National Cancer Institute	5-R00-CA157954-03-05	9/22/14	8/31/17	Convergence of CREB and MYC Pathways in Oncogenesis	$249,000
Theme Investment	Carey	Anders	Dana Farber Cancer Institute	1230604	8/1/16	7/31/17	Dana-Farber/ Harvard SPORE in Breast Cancer	$10,883
Theme Investment	Eva	Anton	NIH-National Institute of Neurological Disorders and Stroke	R01-NS090029	9/1/15	8/31/19	Mechanisms underlying Joubert syndrome related brain malformations	$468,275
Innovation Award	Paul	Armistead	NIH National Cancer Institute	1-R01-CA201225-01	2/1/16	1/31/21	Leukemia Specific Splice Isoforms as Neo-Antigens for T-Cell Immunotherapy	$442,225
Retention	Kenneth	Ataga	NIH National Heart, Lung, and Blood Institute	4-R01-HL111659-05	1/1/12	12/31/16	Endothelial Dysfunction in the Pathogenesis of Sickle Cell Nephropathy	$474,581
Retention	Kenneth	Ataga	NIH National Heart, Lung, and Blood Institute	4-U01-HL117659-04	8/15/13	5/31/18	Targeted anticoagulant therapy for sickle cell disease	$1,481,743
Recruitment	Jeffrey	Aube	Scripps Research Institute	5-20859	7/1/15	1/31/17	Novel Probes of the Kappa Opioid Receptor; Chemistry, Pharmacology, and Biology	$226,216
Recruitment	Jeffrey	Aube	Fox Chase Cancer Center	FCCC15101-01	9/26/16	8/31/17	Identifying stabilizers of p53 using pocket complementarity	$15,200
Recruitment	Jeffrey	Aube	Scripps Research Institute	5-20983	2/1/17	1/31/21	Novel Probes of the Kappa Opioid Receptor: Chemistry, Pharmacology, and Biology	$203,593
Theme Investment (CC)	David	Aylor	National Inst. of Health	5-ROO-ES021535-04	6/1/12	5/31/17	Epigenetics, environmental exposure, and reproduction in the Collaborative Cross	$238,469
Theme Investment (CC)	Ralph	Baric	NIH National Institute on Aging	5-K99-AG049092-01-02	7/15/15	5/31/17	Systems Based Analysis of Host Factors that Contribute to Aging Pathogenesis	$101,494
Theme Investment (CC)	Ralph	Baric	NIH National Institute of Allergy and Infectious Diseases	3-U19-AI100625-04S1	8/1/15	7/31/17	Unlocking Zika Virus Immune Control and Pathogenesis with the Collaborative Cross	$135,110
Theme Investment (CC)	Ralph	Baric	NIH National Institute of Allergy and Infectious Diseases	5-R01-AI110700-01-02	4/20/15	3/31/20	Mechanisms of MERS-CoV Entry, Cross-species Transmission and Pathogenesis	$739,162
Recruitment	John	Baron	NIH National Cancer Institute	5-R01-CA098286-13	12/1/02	7/31/17	Colorectal Chemoprevention with Calcium and Vitamin D	$2,234,370
Recruitment	Ethan	Basch	National Inst. of Health	5-U24-NR-014637-02	9/28/10	6/30/18	Refinement and Expansion of the Palliative Cooperative Group	$110,620
Recruitment	Ethan	Basch	NIH National Cancer Institute	4-R25-CA116339-09	7/1/05	8/31/18	Cancer Care Quality Research Training Program	$405,045
Recruitment	Ethan	Basch	NIH National Cancer Institute	1-UG1-CA189823-01	8/1/14	7/31/19	Alliance NCORP Research Base	$169,387

Recruitment	Ethan	Basch	Patient-Centered Outcomes Research Institute	ME-1507-32079	8/1/16	12/31/20	Patient-Reported Outcomes-based Performance Measures (PRO-PMs)	$896,837
Retention	Ted	Bateman	University of Colorado Boulder	1554280	7/18/16	6/30/17	Combined Evaluation of Mouse Musculoskeletal Data from Space Shuttle and ISS Experiments to Support the CASIS Good Health Initiative	$118,125
Innovation Award	Victoria	Bautch	NIH National Heart, Lung, and Blood Institute	5-R01-HL117256-01-03	8/1/14	5/31/18	Mechanisms of neovascularization in response to ischemia	$375,662
Innovation Award	James	Bear	NIH National Institute of General Medical Sciences	5-R01-GM111557-01-03	9/1/14	8/31/18	The role of the Arp2/3 complex in cellular actin dynamics	$246,479
Recruitment	Antonia	Bennett	Alliance for Clinical Trials in Oncology Foundation	PCS-1505-30497	7/1/16	12/1/21	Comparison of Operative to Medical Endocrine Therapy (COMET) for Low-Risk DCIS	$820,324
Recruitment/ Theme Investment	Jonathan	Berg	NIH National Human Genome Research Institute	4-U01-HG007437-04	9/23/13	7/31/17	A Knowledge Base for Clinically Relevant Genes and Variants (CRVR/ClinGen)	$131,491
Recruitment/ Theme Investment	Jonathan	Berg	National Inst. of Health	3-U01-HG007437-03S1	9/23/13	7/31/17	CRVR Administrative Supplement - Geisinger	$165,625
Recruitment/ Theme Investment	Jonathan	Berg	NIH National Institute of Child Health and Human Development	4-U19-HD077632-04	9/5/13	8/31/18	NC NEXUS, North Carolina Newborn Exome Sequencing for Universal Screening	$1,177,646
Recruitment	Rosa	Branca	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-R01-DK108231-01-02	9/25/15	8/31/20	Sensitive and Specific Detection of BAT Tissue and Activity by Magnetic Resonance with Hyperpolarized Xe-129	$333,534
Recruitment	M.	Brookhart	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	1-F32-DK109561-01	9/8/16	9/7/17	FELLOW:M ASSIMON Investigating the longitudinal patterns of use and comparative effectiveness of beta blocker therapy in the hemodialysis population	$70,554
Innovation	Keith	Burridge	NIH National Institute of General Medical Sciences	5-R01-GM029860-33-34	4/1/81	3/31/19	Cell Adhesion and the Regulationof Rho GTPases	$451,850
Theme Investment (GeriOnc)	Jan	Busby-Whitehead	NIH National Institute on Aging	5-T35-AG038047-07	5/1/10	5/31/20	UNC-CH Summer Research Training in Aging for Medical Students	$74,455
Theme Investment	John	Buse	NIH National Center for Advancing Translational Sciences	4-UL1-TR001111-04	9/26/13	4/30/18	RPPR CTSA U 2016	$380,000
Recruitment	Mauro	Calabrese	NIH National Institute of General Medical Sciences	1-R01-GM121806-01	1/23/17	12/31/21	Mechanisms of gene silencing induced by long noncoding RNAs	$321,990
Innovation	Sharon	Campbell	NIH National Institute of General Medical Sciences	4-R01-GM106227-04	6/1/13	5/31/17	Regulation of Ras by Monoubiquitination	$378,127
Innovation	Sharon	Campbell	NIH National Institute of General Medical Sciences	1-R01-GM114130-01A1	9/1/16	8/31/19	Structure and function of novel G protein conformations	$304,002
Theme Investment (Protocol)	Lisa	Carey	Dana Farber Cancer Institute	1231004	8/1/16	7/31/17	Dana-Farber/Harvard SPORE in Breast Cancer	$7,255
Theme Investment (Protocol)	Lisa	Carey	NIH National Cancer Institute	5-U10-CA180838-01-03	5/7/14	2/28/19	NCTN Lead Academic Participating Sites Application	$474,318
Innovation	Kathleen	Caron	NIH National Institute of Child Health and Human Development	5-R01-HD060860-06-07	4/1/09	7/31/20	Adrenomedullin Signaling at the Maternal-Fetal Interface	$307,738
Recruitment	Shannon	Carson	NIH National Institute of Nursing Research	5-R01-NR016459-01-02	9/26/16	7/31/21	Prediction of Functional Outcomes from Chronic Critical Illness	$600,144

Recruitment	Xian	Chen	NIH National Cancer Institute	5-U24-CA160035-05	8/1/12	7/31/16	Cancer Proteome Center at Washington University, University of North Carolina & Boise State	$379,563
Recruitment	Ronald	Chen	Patient-Centered Outcomes Research Institute	CER-1310-06453	1/1/15	3/31/18	North Carolina Prostate Cancer Comparative Effectiveness & Survivorship Study (NCProCESS): A Stakeholder-Driven, Population-Based Prospective Cohort Study	$58,869
Recruitment	Ronald	Chen	Alliance for Clinical Trials in Oncology	CER-1503-29220	2/1/16	6/30/19	Optimizing the Effectiveness of Routine Post-Treatment Surveillance in Prostate Cancer Survivors	$827,438
Recruitment	Ronald	Chen	Agency for Healthcare Research and Quality	1-RO1-HS022713-01A1	7/1/14	6/30/19	NC Process: A Stakeholder-Driven, Population-Based Prospective Cohort Study	$696,957
Theme Investment (Training)	Adrienne	Cox	NIH National Cancer Institute	4-T32-CA071341-20	9/30/96	8/31/17	Cancer Cell Biology Training Program	$205,844
Theme Investment (HTSF)	James	Crowley	NIH National Institute of Mental Health	5-R01-MH105500-01-02	1/20/15	11/30/19	Genetic & Environmental Predictors of Tourette Syndrome & OCD in Denmark	$583,361
Theme Investment (HTSF)	James	Crowley	NIH National Institute of Mental Health	5-R01-MH110427-01-02	8/1/16	4/30/21	OCD: Novel Comparative Genomic Approaches to Identify Disease and Treatment Mechanisms	$562,368
Retention	Blossom	Damania	NIH National Institute of Dental and Craniofacial Research	4-R01-DE018281-10	6/1/07	5/31/17	Innate Immunity and KSHV	$365,968
Retention	Blossom	Damania	NIH National Cancer Institute	4-R01-CA096500-14	7/1/02	5/31/18	Role of KSHV Viral Proteins in Signaling and Pathogenesis	$281,108
Retention	Blossom	Damania	NIH National Institute of Dental and Craniofacial Research	4-R01-DE023946-04	9/17/13	7/31/18	Targeting the Epigenome of Gammaherpesviruses in Oral Disease	$378,255
Retention	Blossom	Damania	NIH National Cancer Institute	2-P01-CA019014-37	5/1/97	6/30/21	Herpesviral, Oncogenesis, Latency and Reactivation	$1,811,800
Theme Investment (HTS)	Jeff	Dangl	NIH National Institute of General Medical Sciences	4-R01-GM107444-04	9/1/13	8/31/17	The intersection of development and innate immune system function in arabidopsis	$256,993
Innovation Award	Ian	Davis	Vanderbilt University Medical Center	VUMC58792	9/30/15	11/30/16	Chromatin Maintenance in Cancer Progression	$100,661
Innovation Award	Ian	Davis	NIH National Cancer Institute	4-R01-CA166447-05	5/1/12	3/31/17	Chromatin Organization and Transcription Factor Targeting in Cancer	$304,426
Retention	Paul	Dayton	NIH National Cancer Institute	3-RO1-CA170665-04S1	9/1/12	6/30/16	Pilot Clinical Study of Acoustic Angiography for Improving Ultrasound Sensitivity - Supplement	$196,588
Retention	Paul	Dayton	Vanderbilt University Medical Center	VUMC 57291	12/1/15	3/31/17	Exploiting Notch inhibition as a mechanism to overcome resistance in ccRCC	$83,072
Retention	Paul	Dayton	NIH National Institute of Biomedical Imaging and Bioengineering	5-F32-EB018715-02	5/1/15	4/30/17	FELLOW:BROOKS, L Contrast-enhanced intravascular ultrasound imaging of vascular invasion	$59,970
Retention	Paul	Dayton	Vanderbilt University	VUMC 60090	8/22/16	6/30/17	Fast volumetric treatment using multi-focus insonation and thermal amplification	$58,622
Retention	Paul	Dayton	NIH National Cancer Institute	5-U01-CA189281-01-02	7/17/15	6/30/18	Improving breast ultrasound specificity through SFRP2 targeted molecular imaging	$483,305
Retention	Paul	Dayton	NIH National Cancer Institute	5-F31-CA196216-02	8/1/15	7/31/18	FELLOW:ROJAS, J Novel Ultrasound Molecular Imaging for Assessment of Tumor Response to Therapy	$33,929
Retention	Paul	Dayton	NIH National Cancer Institute	1-F99-CA212227-01	9/21/16	8/31/18	FELLOW:E SHELTON Imaging Cancer Angiogenesis with Acoustic Angiography Ultrasound	$517,234
Retention	Paul	Dayton	NIH National Cancer Institute	5-R01-CA189479-01-03	9/4/14	8/31/18	Academic-Industrial Partnership for Translation of Acoustic Angiography	$514,371

Retention	Paul	Dayton	North Carolina State University	570253	4/13/15	3/31/19	Ultrasound Molecular Imaging to Assess Therapeutic Response	$117,828
Theme Investment (Protocol)	Elizabeth	Dees	Duke University	2035177	4/1/16	2/28/17	Duke-UNC-Wash U Partnership for Early Phase Clinical Trials in Cancer	$97,384
Theme Investment (Proteomics/ HTS)	Channing	Der	NIH National Cancer Institute	5-R01-CA175747-01-03	2/5/14	1/31/19	Mechanisms of PAK1 activation, signaling and tumor resistance	$424,266
Theme Investment (Proteomics/ HTS)	Channing	Der	NIH National Cancer Institute	5-U01-CA199235-01-02	9/1/15	6/30/19	Identification of synthetic lethal interactors in pancreatic cancer	$732,247
Theme Investment (Proteomics/ HTS)	Channing	Der	NIH National Cancer Institute	5-R01-CA042978-29-30	7/1/86	7/31/20	Biological Activity of Ras Oncogenes	$369,223
Innovation	Channing	Der	NIH National Cancer Institute	5-P01-CA203657-01-02	6/1/16	5/31/21	Defining RAS isoform- and mutation-specific roles in oncogenesis	$1,542,424
Innovation Award	Mohanish	Deshmukh	NIH National Institute of General Medical Sciences	4-R01-GM105612-04	4/1/13	3/31/17	Mechanism by which Human ES Cells Prime Bax at the Golgi for Rapid Apoptosis	$324,900
Innovation Award	Mohanish	Deshmukh	NIH National Institute of General Medical Sciences	5-R35-GM118331-01-02	6/1/16	5/31/21	Establishing Apoptotic Thresholds: Insights from Neurons and Stem Cells to Cancer	$523,601
Theme Investment	Shengli	Ding	NIH-National Institute on Aging	R01-AG041198	7/1/16	6/30/18	Aging intestinal stem cells and insulin/IGF system	$154,623
Retention	Dirk	Dittmer	Tulane University	TUL-HSC-555238-17/18	4/1/17	3/31/18	Exosome Origin in HIV Pathogenesis	$53,437
Retention	Dirk	Dittmer	NIH National Institute of Dental and Craniofacial Research	4-R01-DE018304-09	5/15/07	8/31/18	ART Modulation of Viral Pathogenesis	$377,837
Retention	Dirk	Dittmer	NIH National Institute on Drug Abuse	5-R01-DA040394-01-02	7/1/15	6/30/20	HIV and substances of abuse influence exosomes and endothelial cell function	$368,240
Retention	Dirk	Dittmer	NIH National Cancer Institute	Not Assigned	9/1/15	8/31/20	AIDS Malignancy Laboratory Consorium (AMC)	$62,394
Retention	Dirk	Dittmer	NIH National Cancer Institute	2-R01-CA163217-06	9/1/11	7/31/21	Targeted Therapies for HIV-Associated Kaposi Sarcoma and Lymphoma	$342,759
Recruitment	Claire	Doerschuk	NIH National Heart, Lung, and Blood Institute	4-R01-HL114388-05	6/1/12	3/31/17	Rho-mediated signaling in lung endothelial cells induced by neutrophil adhesion	$219,458
Recruitment	Claire	Doerschuk	NIH National Heart, Lung, and Blood Institute	4-T32-HL007106-40	7/1/75	3/31/17	Multidisciplinary research training in pulmonary diseases	$442,058
Recruitment	Claire	Doerschuk	NIH National Heart, Lung, and Blood Institute	4-K12-HL119998-04	9/1/13	5/31/18	Application of Omics in Lung Disease	$349,342
Recruitment	Claire	Doerschuk	National Inst. of Health	5-P50-HL120100-03	9/19/13	8/31/18	The Impact of Tobacco Exposure on the Lungs Innate Defense System: Project 3 - Mouse Models of Smoking-related Diseases: What is the Best Mimic of Human Disease	$654,857
Retention	Nikolay	Dokholyan	NIH National Institute of General Medical Sciences	5-R01-GM114015-01-02	8/15/16	5/31/20	Integrating cheminformatics and molecular simulations for virtual drug screening	$293,344
Retention	Nikolay	Dokholyan	NIH National Institute of General Medical Sciences	1-R01-GM123247-01	5/1/17	3/31/21	Engineering allostery for in vivo protein control	$537,595
Recruitment	Gianpietro	Dotti	DOD DA Army Medical Research Acquisition Activity	W81XWH-16-1-0332	8/15/16	8/14/17	Exploiting Hypoxia for T-Cell Immunotherapy in Neuroblastoma	$114,000

Recruitment	Gianpietro	Dotti	Houston Methodist Research Institute (The Methodist Hospital)	11030002-143	5/1/16	4/30/18	Bispecific Cytotoxic Lymphocytes in HIV-related Lymphoma	$7,006
Recruitment	Gianpietro	Dotti	DOD DA Army Medical Research Acquisition Activity	W81XWH-16-1-0501	9/1/16	8/31/19	Strategies to Counteract Resistance Mechanisms in CAR + T Cell-based Immunotherapy for Triple Negative Breast Cancer	$199,953
Recruitment	Gianpietro	Dotti	NIH National Cancer Institute	1-R01-CA193140-01A1	2/1/16	1/31/21	Targeting the Ig-Light Chains with CAR-T Cells in Lymphoid Tumors	$569,255
Innovation Award	Andrew	Dudley	NIH National Cancer Institute	5-R01-CA177875-01-03	9/1/14	8/31/19	Mechanisms of tumor escape from anti-angiogenic therapy	$312,777
Innovation Award	Stacie	Dusetzina	University of Chicago	FP064058-A	6/1/16	5/31/17	Access to and Value of Treatment Innovation Study	$202,995
Theme Investment (CBCS)	Shelton	Earp	NIH National Cancer Institute	4-P50-CA058223-23	8/5/97	8/31/17	SPORE in Breast Cancer	$1,725,265
Theme Investment (CBCS)	Shelton	Earp	NIH National Cancer Institute	5-U54-CA156733-06-07	9/28/10	8/31/20	NCCU-LCCC Partnership in Cancer Research (2 of 2)	$997,277
Innovation	Timothy	Elston	DOD DA Army Research Office	W911NF-15-1-0631	9/28/15	9/27/17	Spatio-temporal control of Rho family signaling networks in motility	$130,000
Recruitment	Michael	Emanuele	NIH National Institute of General Medical Sciences	1-R01-GM120309-01	9/1/16	8/31/21	SCF Ubiquitin Ligases in Cell Cycle Control and Chromosome Stability	$301,840
Theme Investment (HTS)	James	Evans	NIH National Human Genome Research Institute	3-U01-HG006487-04S1	12/1/14	5/31/17	NC GENES: North Carolina Clinical Genomic Evaluation by NextGen Exome Sequencing Supplement to 5032286	$1,508,968
Theme Investment (HTSF)	Marty	Farrell	NIH National Institute of Mental Health	1-K01-MH108894-01A1	8/8/16	7/31/20	MARTILIAS FARRELL The Genomics of Highly Treatment Resistant Schizophrenia	$141,831
Recruitment	Hector	Franco	NIH National Cancer Institute	4-R00-CA204628-02	2/17/17	1/31/20	Mechanisms of FoxA1 Latent Enhancer Formation in Response to Proinflammatory Signaling in Hormone Dependent Cancers	$29,803
Recruitment	Rebecca	Fry	National Inst. of Health	5-R01-ES019315-05	9/20/10	5/31/16	In Utero Exposure to Arsenic, Links to Epigenetic Alterations and Disease	$363,075
Recruitment	Rebecca	Fry	University of Georgia	RR715-234/S000725	2/5/15	11/30/16	Functional interaction between the gut microbiome and arsenic exposure	$18,466
Recruitment	Rebecca	Fry	NIH National Institute of Environmental Health Sciences (NIEHS)	1-R13-ES027335-01	7/1/16	6/30/17	Prenatal environmental toxicants: risk factors for infectious disease in children	$8,000
Recruitment	Rebecca	Fry	Duke University	203-6060	3/1/17	2/28/18	Protecting Neurodevelopment In Latino Migrant Children by Reduced Exposure to Organophosphate Pesticides	$28,707
Recruitment	Stephen	Frye	NIH National Institute of General Medical Sciences	2-R01-GM100919-05A1	5/1/12	7/31/20	Discovery of Chemical Probes for Chromatin Readers	$429,687
Recruitment	Terry	Furey	National Inst. of Health	1-RO1-ES024983-02	12/1/14	11/30/16	Interpreting Molecular Role of DNA Variants Associated with Crohn's Disease Through Integrative Analysis of Open Chromatin, Epigenome and Transcriptome Data in Diverse and Relevant Tissues and Cells	$300,204
Recruitment	Terry	Furey	NIH National Institute of Environmental Health Sciences	4-R01-ES023195-04	8/26/13	5/31/17	Genes, genomes and genotoxicity; in vivo epigenetic toxicology of 1,3-butadiene	$546,211
Recruitment	J Victor	Garcia-Martinez	National Inst. of Health	5-RO1-AI097012-05	12/1/15	11/30/16	Mode of action of a new Tat HIV-1 inhibitor	$185,000
Recruitment	J Victor	Garcia-Martinez	NIH National Institute of Allergy and Infectious Diseases	5-R01-AI111899-01-03	3/1/14	2/28/19	Plug & Purge: In Vivo Targeting of Active HIV Reservoirs That Persist Despite ART	$521,436

Recruitment	J Victor	Garcia-Martinez	NIH National Institute of Mental Health	5-R01-MH108179-01-02	4/1/15	1/31/20	Role of Myeloid Cells in HIV latency in the Periphery and the CNS	$482,900
Recruitment	Timothy	Gershon	NIH National Cancer Institute	5-F30-CA192832-02	3/25/15	12/24/19	FELLOW:YUN LONG LANG ATR: a novel therapeutic target for medulloblastoma identified by its role in cerebellar development	$33,814
Recruitment	Timothy	Gershon	NIH National Institute of Neurological Disorders and Stroke	5-R01-NS088219-01-02	2/15/15	1/31/20	Glycolytic regulation of cerebellar development and medulloblastoma tumorigenesis	$327,837
Theme Invest (HTS)	Paola	Giusti	NIH National Institute of Mental Health	1-K01-MH109772-01	4/1/16	3/31/20	Interpreting GWAS associations in schizophrenia using genome-wide chromatin mapping	$155,168
Innovation	Bob	Goldstein	National Inst. of Health	5-F32-GM119348-02	8/2/16	7/31/18	FELLOW:M SLABODNICK Investigating the mechanisms that regulate apical constriction during C. elegans gastrulation	$57,066
Innovation	Bob	Goldstein	NIH National Institute of General Medical Sciences	2-R01-GM083071-09	6/1/08	7/31/20	C. elegans Gastrulation: a Model for Understanding Apical Constriction Mechanisms	$334,215
Retention	Satish	Gopal	NIH Fogarty International Center for Advanced Study in the Health Sciences	4-K01-TW009488-05	9/20/12	6/30/17	Developing a clinical cohort of histopathologically characterized lymphoma	$140,175
Retention	Satish	Gopal	NIH National Cancer Institute	1-P20-CA210285-01	9/1/16	8/31/18	Planning for a National Non-Communicable Disease Center of Research Excellence in Malawi	$264,816
Retention	Satish	Gopal	NIH National Cancer Institute	1-U54-CA190152-02	9/15/14	8/31/19	Addressing Herpesviruses-Associated Cancers Through the UNC-Malawi Cancer Consortium	$749,896
Theme Investment (HTS)	Penny	Gordon-Larsen	NIH National Institute of Child Health and Human Development	5-R01-HD057194-06-08	1/1/08	6/30/19	Exome Variants Underlying Weight Gain from Adolescence to Adulthood	$596,111
Recruitment	Gaorav	Gupta	NIH National Cancer Institute	5-F32-CA206345-02	6/1/16	5/31/19	FELLOW: K FAGAN-SOLIS Identifying Drivers of Genomic Instability in Triple-Negative Breast Cancer	$60,990
Recruitment	Gaorav	Gupta	NIH National Cancer Institute	1-F32-CA206345-01	6/1/16	5/31/19	FELLOW:K FAGAN-SOLIS Identifying Drivers of Genomic Instability in Triple-Negative Breast Cancer	$58,002
Recruitment	Stephanie	Gupton	NIH National Institute of Mental Health	5-R21-MH109653-01-02	5/15/16	4/30/18	Identification of ubiquitnated neural substrates of TRIM9 and TRIM67	$171,000
Recruitment	Stephanie	Gupton	NIH National Institute of General Medical Sciences	5-R01-GM108970-01-03	1/1/14	12/31/18	TRIM9 coordinates membrane trafficking and cytoskeletal dynamics	$349,992
Recruitment	Stephanie	Gupton	NIH National Institute of Neurological Disorders and Stroke	1-F31-NS096823-01	3/15/16	3/14/19	FELLOW:N BOYER TRIM67 regulates growth cone filopodia during netrin-dependent axon guidance	$33,935
Retention	Klaus	Hahn	National Inst. of Health	5-RO1-GM102924-04	8/1/12	5/31/16	A Toolkit for Imaging and Photo-Manipulation of Signaling in Zebrafish	$310,929
Retention	Klaus	Hahn	University of Wisconsin at Madison	647K662	12/8/15	11/20/16	Mechanisms of cell migration on aligned matrices	$104,122
Retention	Klaus	Hahn	NIH National Cancer Institute	5-F31-CA192739-02	7/1/15	6/30/18	FELLOW:STONE, O Cancer metastasis studied via optically controlled cofilin and LIM kinase analogs	$33,935
Retention	Klaus	Hahn	NIH National Institute of General Medical Sciences	4-P01-GM103723-04	9/30/13	7/31/18	Spatio-temporal dynamics of GEF-GTPase networks	$1,101,950
Retention	Klaus	Hahn	NIH National Institute of General Medical Sciences	1-F32-GM120958-01	8/1/16	7/31/19	FELLOW:N PINKIN Improving Environment Sensitive Dyes for Live Cell Single Molecule Imaging	$54,294
Retention	Klaus	Hahn	NIH National Institute of General Medical Sciences	5-F32-GM120958-02	8/1/16	7/31/19	FELLOW:N PINKIN Improving Environment Sensitive Dyes for Live Cell Single Molecule Imaging	$57,066
Theme Investment	Scott	Hammond	NIH-NIH National Cancer Institute	R21-CA196379	9/1/15	8/31/18	An optimized design for single copy short hairpin RNAi	$198,360
Retention	Zongchao	Han	NIH National Eye Institute	1-R01-EY026564-01	4/1/16	3/31/21	Targeting Retinitis Pigmentosa Using Nanoparticle-Mediated Delivery of Genomic DNA	$360,448

Innovation	Laura	Hanson	Duke University	2035449	7/1/16	6/30/17	Refinement and Expansion of the Palliative Care Research Cooperative Group (PCRC)	$96,242
Recruitment	Liza Makowski	Hayes	NIH National Cancer Institute	5-R21-CA180134-02	8/7/13	7/31/16	(PQA2) Reversing Carcinogenic Effect of Obesity on Basal-like Breast Cancer	$154,570
Theme Investment (HTS)	Neil	Hayes	NIH National Cancer Institute	5-U10-CA181009-01-03	4/22/14	2/28/19	Network Group Integrated Translational Science Centers Application	$700,000
Theme Investment (CC)	Mark	Heise	NIH National Institute of Allergy and Infectious Diseases	4-U19-AI100625-05	8/5/12	7/31/17	Systems Immunogenetics of Biodefense Pathogens in the Collaborative Cross - Project 2	$567,117
Theme Investment	Mark	Heise	NIH National Institute of Allergy and Infectious Diseases	NIH/NIAD-R21AI119933	2/15/16	1/31/18	Host Genetic Control of Chikungunya Virus-induced Arthritis	$209,000
Theme Investment (HTS)	Gail	Henderson	NIH National Human Genome Research Institute	1-K99-HG008819-01	9/18/15	8/31/17	Use of Genetic Information by Life, Long-term Care, and Disability Insurers: Exploring International Lessons, the Domestic Legal Landscape, and Options for U.S. Policy	$91,113
Theme Investment (HTS)	Gail	Henderson	NIH National Human Genome Research Institute	4-P50-HG004488-09	9/27/07	5/31/18	Center for Genomics and Society	$1,188,966
Theme Investment (HTS)	Gail	Henderson	NIH National Institute of Allergy and Infectious Diseases	5-R01-AI127024-01-02	6/15/16	5/31/20	Integrating Decision Making Studies into HIV Cure Trials: A real-time longitudinal assessment	$549,859
Recruitment	Shawn	Hingtgen	North Carolina State University	2017-1369	2/1/17	1/31/20	3D Printing of Fibrous Tissue Engineered Medical Products: A New Paradigm for Tissue Biofabrication and Therapeutics	$55,000
Recruitment	Shawn	Hingtgen	NIH National Institute of Neurological Disorders and Stroke	5-R01-NS097507-01-02	6/1/16	5/31/21	Nanofiber matrices to improve neural stem cell-mediated cancer therapy	$324,312
Theme Investment (HTS)	Katherine	Hoadley	NIH National Cancer Institute	1-U24-CA210988-01	9/1/16	8/31/21	RNA sequencing analysis of Cancer	$416,184
Theme Investment (Nanotech)	Leaf	Huang	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	4-R01-DK100664-04	9/10/13	6/30/18	Hepatic Non-viral Gene Therapy	$330,600
Theme Investment (Nanotech)	Leaf	Huang	NIH National Cancer Institute	5-U54-CA198999-01-02	8/1/15	7/31/20	Nano Approaches to Modulate Host Cell Response for Cancer Therapy	$2,261,936
Recruitment	Stephen	Hursting	NIH National Cancer Institute	5-R35-CA197627-01-02	8/1/15	7/31/22	Breaking the Obesity-Cancer Link: New Targets and Strategies	$762,608
Retention	Joseph	Ibrahim	University of Texas MD Anderson Cancer Center	00004510	5/1/16	6/30/19	Statistical Analysis of Biomedical Imaging Data in Curved Space	$207,407
Theme Investment (Bios/HTS)	Joseph	Ibrahim	NIH National Institute of General Medical Sciences	2-R01-GM070335-17	3/1/96	6/30/20	Bayesian Approaches to Model Selection for Survival Data	$425,722
Theme Investment (Bios/HTS)	Joseph	Ibrahim	NIH National Cancer Institute	2-T32-CA106209-11	5/1/04	7/31/21	Biostatistics for Research in Genomics and Cancer	$146,168
Theme Investment (Proteomics)	Gary	Johnson	NIH National Institute of Mental Health	5-U01-MH104999-01-03	8/1/14	4/30/17	Activation and Regulation of the Understudied Kinome Using MIB/MS Technology	$260,636

Theme Investment (Proteomics)	Gary	Johnson	Childrens Hospital of Philadelphia	961188-RSUB	7/1/14	5/31/17	Targeting Oncogenic ALK Signaling in Neuroblastoma	$50,744
Theme Investment (Proteomics)	Gary	Johnson	NIH National Cancer Institute	1-U54-CA196519-01	7/1/15	6/30/20	Developmental and Hyperactive Ras Tumor SPORE (Omics Core)	$400,702
Recruitment	Alexander	Kabanov	NIH National Cancer Institute	5-U01-CA151806-05	9/20/10	7/31/16	High Capacity Nanocarriers for Cancer Chemotherapeutics	$379,186
Recruitment	Alexander	Kabanov	NIH National Cancer Institute	1-RO1-CA184088-01A1	9/1/14	8/31/19	Liposomal Doxorubicin and Pluronic Combination for and Cancer Therapy	$344,549
Recruitment	Alexander	Kabanov	NIH National Cancer Institute	5-R01-CA184088-01-02	1/1/15	12/31/19	PEGylated Liposomal Doxorubicin and Pluronic Combination for and Cancer Therapy	$344,549
Recruitment	Alexander	Kabanov	NIH National Cancer Institute	5-T32-CA196589-02	7/1/15	6/30/20	Carolina Cancer Nanotechnology Training Program (C-CNTP)	$395,375
Recruitment	Alexander	Kabanov	NIH National Cancer Institute	5-U01-CA198910-01-02	8/14/15	7/31/20	Targeted Core Shell Nanogels for Triple Negative Breast Cancer	$562,542
Theme Investment (Viral Core)	Tal	Kafri	NIH National Heart, Lung, and Blood Institute	5-R01-HL128119-01-02	9/2/15	6/30/19	Lentiviral vector-based gene therapy and the host genetic background	$564,236
Theme Investment	Samir	Kelada	NIH National Heart, Lung, and Blood Institute	NIH/NHLBI-R01HL122711-01A1	8/15/15	5/31/19	Systems-level transcriptomic analyses to Identify mouse models of asthma	$314,346
Theme Investment	Samir	Kelada	NIH-National Institute of Environmental Health Sciences	NIH/NIEHS-R01ES024965	1/5/15	10/31/19	Gene-Environment Interactions with Ozone in Experimental Asthma	$258,172
Retention	Nigel	Key	University of Washington	UWSC8675 (BPO9467)	8/15/15	5/31/17	Trial Using Epsilon Aminocaproic Acid in Therapy in Thrombocytopenia (TREAT)	$297,013
Retention	Nigel	Key	NIH National Heart, Lung, and Blood Institute	4-T32-HL007149-40	7/1/75	6/30/17	Research Training in Hematology at UNC Chapel Hill	$124,743
Recruitment	Melina	Kibbe	Northwestern University	60043052	7/1/16	5/31/18	Novel Vehicles for Targeted Cardiovascular Repair	$493,754
Recruitment	Melina	Kibbe	Northwestern University	SP0039578-PROJ0011872	8/1/16	7/31/18	Preclinical Investigation of a Bioengineered Vascular Graft	$140,623
Recruitment	Melina	Kibbe	University of Cincinnati	010635-002	10/24/16	10/23/19	Development of a Targeted Intravascular Therapy to Stop Non-Compressible Torso Hemorrhage	$269,603
Retention	William	Kim	NIH National Cancer Institute	1-F31-CA213985-01	9/30/16	6/29/19	FELLOW:ALEISHA M SMITH Investigating HIF-MYC interactions within a Clear Cell Renal Cell Carcinoma Murine Model	$29,609
Retention	William	Kim	NIH National Cancer Institute	5-1R01CA202053-01-02	8/1/16	7/31/21	Kinase Inhibition in Kidney Cancer	$432,423
Recruitment	Christine	Kistler	Beth Israel Deaconess Medical Center	01027406	6/12/14	5/31/17	Randomized Trial of a Mammography Decision Aid for Women Aged 75 and Older	$159,820
Recruitment	Christine	Kistler	Agency for Healthcare Research and Quality	1-R01-HS024519-01	4/1/16	3/31/19	Nurse and Physician Decision-making for Suspected Urinary Tract Infections in Nursing Homes: Potential Targets to Reduce Antibiotic Overuse	$497,425
Theme Investment (HTS)	Michael	Knowles	NIH National Heart, Lung, and Blood Institute	5-U54-HL096458-11-13	8/6/04	7/31/19	Genetic Disorders of Mucociliary Clearance	$1,242,974
Theme Investment (Bios)	Michael	Kosorok	National Science Foundation	DMS-1407732	7/1/14	6/30/17	Support Vector Machines for Censored Data	$139,000
Theme Investment (Bios)	Michael	Kosorok	NIH National Cancer Institute	5-P01-CA142538-06-07	4/1/10	3/31/20	Statistical Methods for Cancer Clinical Trials	$1,977,577

Theme Investment (Bios)	Michael	Kosorok	NIH National Cancer Institute	8-T32-LM012420-02	5/1/15	4/30/20	Big Data Visualization Methods and Software for Population Health Research	$297,372
Recruitment	Alain	Laederach	NIH National Heart, Lung, and Blood Institute	4-R01-HL111527-05	1/1/12	12/31/16	Non-coding RNA structure change in Chronic Obstructive Pulmonary Disease	$360,062
Recruitment	Alain	Laederach	NIH National Human Genome Research Institute	5-R01-HG008133-01-02-03	9/1/15	6/30/18	Predicting the causative SNPs in LD blocks by allele-specific structural analysis of the transcriptome	$600,038
Recruitment	Alain	Laederach	University of Michigan Ann Arbor	3004537869	5/1/17	2/28/19	Spliceosome mechanism dissected at the single molecule level	$49,131
Recruitment	Jennifer	Lafata	Virginia Commonwealth University	FP00003673_SA001	8/1/16	2/28/18	Sub to VCU: An Interactive Preventive Health Record to Increase Colorectal Cancer Screening	$698,300
Recruitment	Jennifer	Lafata	NIH National Cancer Institute	7-R01-CA197205-02	8/1/16	7/31/20	e-Assist: A Post-Visit Patient Portal Tool to Promote Colorectal Cancer Screening	$324,737
Recruitment	Samuel K.	Lai	National Science Foundation	DMR-1151477	4/15/12	3/31/17	Synthetic Nanoprobes Reveal Novel Biophysical Immune Protective Mechanism of Mucus	$79,999
Recruitment	Samuel K.	Lai	NIH National Institute of Dental and Craniofacial Research	5-F32-DE026683-02	9/1/16	8/31/18	FELLOW:T JACOBS Engineering Temperate Bacteriophages for Induced Secretion of Proteins and Peptides by Oral Streptococcus Mitis	$57,866
Innovation	David	Lawrence	NIH National Cancer Institute	1-R01-CA203032-01	2/2/16	1/31/21	Single Cell Sampling of Signaling Activity in Triple Negative Breast Cancer	$466,217
Recruitment	Helen	Lazear	NIH National Institute of Allergy and Infectious Diseases	1-R21-AI129431-01	11/10/16	10/31/18	Viral and host determinants of Zika virus tissue tropism	$228,000
Recruitment	Stanley	Lemon	NIH National Cancer Institute	4-R01-CA164029-05	5/1/12	3/31/17	Murine Model of HCV-Associated Human Liver Cancer	$470,695
Recruitment	Stanley	Lemon	NIH National Institute of Allergy and Infectious Diseases	4-R01-AI103083-05	9/24/12	8/31/17	Membrane Hijacking: Biogenesis and Fate of Enveloped Hepatovirus	$380,000
Recruitment	Stanley	Lemon	NIH National Institute of Allergy and Infectious Diseases	2-R01-AI095690-06	4/15/11	3/31/21	Micro-RNA 122 and Chronic Hepatitis C	$380,000
Recruitment	Stanley	Lemon	NIH National Institute of Allergy and Infectious Diseases	1-R01-AI131685-01	3/6/17	2/28/22	Murine Model of Human Hepatitis A	$385,833
Recruitment	Zibo	Li	NIH National Institute of Biomedical Imaging and Bioengineering	5-R01-EB014354-02-04	9/23/13	6/30/17	The Tetrazine Ligation for Efficient 18F Labeling and Pretargeted Imaging/Radiotherapy of Cancer	$330,463
Recruitment	Zibo	Li	University of Georgia	RR168-708/S001393	3/15/17	1/31/18	Nanoscintillator-based X-ray sensitizers to enable efficient non-small cell lung cancer treatment with X-ray irradiation	$190,621
Recruitment	Zibo	Li	NIH Office of the Director	1-S10-OD023611-01	3/17/17	3/16/18	Small Animal PET/CT for Preclinical Imaging Research	$834,500
Retention/ Theme Investment	Weili	Lin	NIH National Institute of Neurological Disorders and Stroke	1-R21-NS095027-01A1	8/15/16	7/31/18	Characterizing morphological and hemodynamic characteristics of human brain perivascular spaces with aging using 7T MRI	$228,000
Retention/ Theme Investment	Weili	Lin	NIH National Institute of Mental Health	1-U01-MH110274-01	9/1/16	5/31/20	UNC/UMN Baby Connectome Project	$595,575
Retention/ Theme Investment	Laura A.	Linnan	Centers for Disease Control	2-R49-CE002479-01	8/1/14	7/31/19	UNC Injury Prevention Research Center	$408,961
Retention	Laura A.	Linnan	Centers for Disease Control	3-U48-DP005017-01S1	9/30/14	9/29/19	SIP 14-030 UNC Coordinating Center of the Worksite Health Research Network - Supplement	$66,177
Retention	Laura A.	Linnan	Centers for Disease Control	Not Assigned	9/30/14	9/29/19	SIP 14-031 UNC Collaborating Center of the Worksite Health Research Network	$149,926

Recruitment	Pengda	Liu	NIH National Cancer Institute	4-R00-CA181342-03	7/1/14	2/28/19	Elucidating a Novel Akt Activation Mechanism for Targeted Prostate Cancer Therapy	$217,518
Retention	P. Kay	Lund	National Inst. of Health	5-R01-AG041198-04	8/1/12	6/30/17	Aging Intestinal Stem Cells and Insulin/IGF System	$300,013
Theme Investment (CC)	Terry	Magnuson	DOD DA Army Medical Research Acquisition Activity	W81XWH-16-1-0233	7/15/16	7/14/18	Co-occurent mutations in chromatin regulators define genetically distinct forms of cancer	$399,326
Theme Investment (CC)	Terry	Magnuson	NIH Office of the Director	5-U42-OD010924-16-17	9/30/99	2/28/20	A Carolina Center to Characterize and Maintain Mutant Mice	$1,339,761
Theme Investment (CC)	Terry	Magnuson	NIH National Institute of General Medical Sciences	2-R01-GM101974-28	12/1/89	3/31/20	Albino Deletion Complex and Early Mouse Development	$409,640
Recruitment	Ben	Major	NIH National Cancer Institute	5-R21-CA178760-01-02	9/1/14	3/31/17	Mass Spectrometry-coupled Hypermorphic Functional Genomics	$164,360
Recruitment	Ben	Major	University of Toledo	F-2016-26	5/1/16	4/30/18	RhoG Signaling in Invadopodia	$11,075
Recruitment	Ben	Major	University of Toledo	F-2017-106	7/19/16	6/30/18	A Novel RhoG Protein Interaction Network in Invadopodia	$11,075
Recruitment	Ben	Major	University of Arizona	NULL	7/15/16	6/30/20	Arsenic, Nrf2 and autophagy dysfunction in type II diabetes	$15,059
Recruitment	Ben	Major	NIH National Cancer Institute	5-R01-CA187799-01-02	7/1/15	6/30/20	Role of FOXP1 and WNT signaling in B-cell Lymphoma	$307,500
Innovation	Greg	Matera	NIH National Institute of General Medical Sciences	1-R01-GM118636-01	4/1/16	3/31/20	In vivo models of small RNP biogenesis and Spinal Muscular Atrophy	$296,629
Theme Investment (ICISS)	Anne Marie	Meyer	University of Colorado Denver	FY16.804.001	1/5/16	12/31/17	Improving Targeted Colorectal Cancer Screening in the Elderly	$123,503
Recruitment	Edward	Miao	NIH National Institute of Allergy and Infectious Diseases	4-R01-AI097518-05	2/1/12	1/31/17	Inflammasome Response to Bacterial Infection	$401,923
Recruitment	Edward	Miao	NIH National Institute of Allergy and Infectious Diseases	5-R01-AI119073-01-02	5/1/15	4/30/20	Role of caspase-11 in innate immunity	$341,839
Infrastructure /Theme Investment	Ryan	Miller	NIH National Cancer Institute	1-R01-CA204136-01A1	12/13/16	11/30/19	Credentialing murine models for glioblastoma preclinical drug development	$241,390
Theme Investment (HTS)	Karen	Mohlke	National Inst. of Health	5-R01-DK093757-04	9/5/11	7/31/16	Genetic Epidemiology of Rare and Regulatory Variants for Metabolic Traits	$586,255
Theme Investment (HTS)	Karen	Mohlke	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-R01-DK072193-10-11	9/1/05	5/31/19	Targeted Genetic Analysis of T2D and Quantitative Traits	$534,229
Theme Investment (HTS)	Karen	Mohlke	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-U01-DK105561-01-02	5/1/15	4/30/20	Functional genetic variants for type 2 diabetes	$426,659
Recruitment	Cary	Moody	NIH National Cancer Institute	5-R01-CA181581-01-03	9/11/14	8/31/19	Regulation of Human Papillomavirus Replication by the DNA Damage Response	$315,400
Recruitment	Nathaniel	Moorman	NIH National Institute of Allergy and Infectious Diseases	4-R01-AI103311-04	12/1/12	11/30/17	The role of host and viral translation factors during HCMV infection	$444,704
Recruitment	Nathaniel	Moorman	NIH National Institute of Allergy and Infectious Diseases	1-R21-AI123811-01	2/1/16	1/31/18	Hybrid Sequencing to Define the Full-Length Transcriptome of Double Stranded DNA Viruses	$225,672

Recruitment	Stergios	Moschos	Leidos Biomedical Research, Inc.	17X011	5/24/17	5/23/22	A Phase 2 Study of Ibrutinib (PCI-32765) in Refractory Distant Metastatic Cutaneous Melanoma: Correlation of Biomarkers with Response and Resistance*** Sponsor: Leidos is providing multicenter correlative/support funding is related to the NCI9922 Clinical Trial which is being conducted under a existing grant funding	$64,319
Recruitment	Hy	Muss	City of Hope National Medical Center	23030.1000102.669202	5/1/16	4/30/18	Clinical and Biological Predictors of Chemotherapy Toxicity in Older Adults with Cancer	$56,058
Recruitment	Wanda	Nicholson	Johns Hopkins University	2605	3/1/16	8/31/17	Defining a patient-centered research and health agenda for women with diabetes using the DSNet	$50,119
Recruitment	Wanda	Nicholson	Agency for Healthcare Research and Quality	1-P50-HS023418-01	9/1/14	8/31/19	Comparing Options for Management: Patient-Centered Results in Uterine Fibroids (COMPARE-UF)	$175,549
Theme Investment	Marc	Niethammer	National Science Foundation	ECCS-1610762	9/1/16	8/31/19	Dynamic Network Analysis: Analyzing the Chronnectome	$356,420
Recruitment	Seth	Noar	NIH National Institute on Drug Abuse	1-R03-DA041869-01	4/1/16	3/31/18	Systematic Review of Perceived Message Effectiveness Measures for Anti-Tobacco Communication	$111,300
Theme Investment (HTS)	Andrew	Nobel	North Carolina State University	2014-0236-01	8/15/13	6/30/17	Systems Approaches to link tissue-specific expression to disease	$151,031
Innovation	Amy	Oldenburg	NIH National Heart, Lung, and Blood Institute	5-R01-HL123557-01-02	9/1/15	8/31/18	Anatomic optical coherence tomography for quantitative bronchoscopy	$509,436
Theme Investment (CBCS)	Andrew	Olshan	Vanderbilt University Medical Center	VUMC 58928	1/1/16	6/30/17	Breast Cancer Genetic Study in African-Ancestry Populations	$14,518
Theme Investment (CBCS)	Andrew	Olshan	SUNY Buffalo Roswell Park Cancer Institute	76-01	8/1/15	7/31/17	Epidemiology of Breast Cancer Subtypes in African-American Women: a Consortium	$656,534
Theme Investment (HTS)	Andrew	Olshan	National Inst. of Health	5-RO1-DE023414-02	8/1/14	7/31/19	Exome Sequencing for Head and Neck Cancer Susceptibility Genes	$12,308
Theme Investment (CC)	Fernando	Pardo Manuel de Villena	NIH National Institute of Mental Health	5-F30-MH103925-03	9/8/14	9/7/18	FELLOW:MORGAN, ANDREW Effects of advanced paternal age on germline genome stability	$41,981
Theme Investment (CC)	Fernando	Pardo Manuel de Villena	National Inst. of Health	1-F30-MH103925-01A1	9/8/14	9/7/18	Effects of Advanced Paternal Age on Germine Genome Stability	$33,035
Recruitment	Kenneth	Pearce	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-R01-DK101645-01-02	7/1/15	4/30/18	High Throughput Screening Assay for IP7K inositol pyrophosphate kinases	$342,000
Theme Investment (HTS)	Mark	Peifer	National Inst. of Health	5-R01-GM067236-11	9/1/08	7/31/16	A Model System to Study the Tumor Suppressor APC	$255,910
Theme Investment (HTS)	Mark	Peifer	NIH National Institute of General Medical Sciences	1-F32-GM117803-01A1	9/1/16	8/31/18	FELLOW:A SPRACKLEN, Defining How Abelson Kinase Regulates Cell Adhesion and Actin Dynamics	$56,829
Theme Investment (HTS)	Mark	Peifer	NIH National Institute of General Medical Sciences	5-R35-GM118096-01-02	7/1/16	6/30/21	Regulating cell fate and shaping the body plan during morphogenesis and oncogenesis	$583,645

Theme Investment (HTS, CBCS, MP1U)	Charles	Perou	NIH National Cancer Institute	5-R01-CA195740-01-02	6/1/15	5/31/18	Credentialing Mouse Models for Immune System Therapy Research	$581,304
Theme Investment (HTS, CBCS, MP1U)	Charles	Perou	NIH National Cancer Institute	5-R01-CA195754-01-02	8/1/15	7/31/18	Mouse Models of Metastatic Triple-Negative Breast Cancer for Therapeutic Testing	$572,521
Theme Investment (HTS, CBCS, MP1U)	Charles	Perou	NIH National Cancer Institute	5-F32-CA210427-02	8/1/16	7/31/19	FELLOW:D HOLLERN Identifying Effective Immune Checkpoint Therapy Strategies in Triple Negative Breast Cancer	$56,694
Theme Investment (HTS, CBCS, MP1U)	Charles	Perou	NIH National Cancer Institute	5-R01-CA148761-06-07	3/17/10	8/31/20	Therapeutic Targeting of Breast Cancer Tumor Initiating Cells	$393,933
Retention	Ben	Philpot	NIH National Institute of Mental Health	4-R01-MH093372-05	12/9/11	11/30/16	Epigenetic Regulation of Ube3a as a Treatment for Angelman Syndrome	$591,194
Retention	Ben	Philpot	NIH National Institute of Neurological Disorders and Stroke	5-R01-NS085093-01-03	2/1/14	1/31/18	Role of UBE3A in the Central Nervous System	$321,269
Recruitment	Gianmarco	Pinton	NIH National Institute of Neurological Disorders and Stroke	5-R01-NS091195-01-02	4/1/15	3/31/20	Shear shock wave propagation in the brain: high frame-rate ultrasound imaging, characterization, and simulations	$313,623
Theme Investment (HTS)	Jan	Prins	NIH National Human Genome Research Institute	5-F31-HG008912-02	6/1/16	5/31/18	FELLOW:J WELCH Computational Modeling of Heterogeneous Gene Expression in Single Cells	$33,727
Recruitment	Jeremy	Purvis	National Institutes of Health	3-ROO-GM120372-04	9/1/12	8/31/16	Dynamics of Cellular Senescence in Single Human Cells	$279,873
Recruitment	Jeremy	Purvis	NIH National Heart, Lung, and Blood Institute	1-F31-HL134336-01A1	9/1/16	8/31/19	FELLOW:R HAGGERTY Single-cell dynamics of the OCT4-GATA6 axis in human lung progenitors	$31,643
Recruitment	Jeremy	Purvis	NIH National Institute of Child Health and Human Development	1-DP2-HD091800-01	9/30/16	6/30/21	Controlling Stem Cell Fate through Computational Modeling	$761,730
Retention	John	Ramsey	US Defense Advanced Research Project Agency	HR0011-12-2-0001	11/7/11	11/5/16	Reconfigurable Multi element Diagnostic ReMeDx	$665,690
Retention	John	Ramsey	NIH National Human Genome Research Institute	4-R01-HG007407-04	8/1/16	10/29/17	Nanofluidic Platforms for High Resolution Mapping of Genomic DNA	$509,472
Recruitment	Naim	Rashid	Fred Hutchinson Cancer Research Center	0000905066	5/1/16	4/30/18	Statistical Methods for RNA-seq Data Analysis	$2,042,296
Innovation Award	Matthew	Redinbo	NIH National Cancer Institute	5-R01-CA207416-01-02	8/1/16	7/31/19	Microbiome-Targeted Probes to Eliminate Chemotherapy-Induced GI Toxicity	$596,764
Innovation Award	Matthew	Redinbo	NIH National Cancer Institute	5-R01-CA098468-11-13	9/23/14	8/31/19	Improving CPT-11 Efficacy Using Structural and Chemical Biology	$263,899
Recruitment	Bryce	Reeve	NIH National Cancer Institute	5-RO1-CA174453-04	9/1/12	7/31/16	PROMIS Validation in Prospective Population-Based Prostate Cancer Research Study	$280,122
Recruitment	Bryce	Reeve	Patient-Centered Outcomes Research Institute	ME-1303-5838	10/1/13	11/30/16	Measuring Patient-Centered Communication for Colorectal Cancer Care and Research	$125,055
Recruitment	Bryce	Reeve	NIH National Cancer Institute	3-R01-CA174453-04S1	9/21/12	7/31/17	Using PROMIS as part of routine clinical care for racially diverse prostate and bladder cancer patients	$150,000
Recruitment	Bryce	Reeve	NIH National Cancer Institute	4-R01-CA175759-04	4/1/13	3/31/19	Creating and Validating Child Adverse Event Reporting in Oncology Trials	$64,858

Recruitment	Bryce	Reeve	NIH National Institute of Arthritis and Musculoskeletal and Skin Diseases	1-U19-AR069522-01	9/30/15	9/29/19	Enhancing Clinical Meaningfulness And Usefulness Of PROMIS Pediatric Measures Via Validation In Children And Adolescents With Rheumatic Disease, Cancer, Or Inflammatory Bowel Disease	$2,719,782
retention	Kurt	Ribisl	NIH National Cancer Institute	5-P50-CA180907-01-03	9/19/13	8/31/18	Effective Communication on Tobacco Product Risk and FDA Authority	$3,971,060
Recruitment	Christine	Rini	National Inst. of Health	5-P60-AR064166-03	7/19/13	6/30/18	NIAMS Multidisciplinary Clinical Research Center	$214,263
Recruitment	Whitney	Robinson	NIH National Cancer Institute	4-K01-CA172717-05	9/11/12	8/31/17	Racial disparities in cancer outcomes: quantifying modifiable mechanisms	$128,245
Recruitment	Whitney	Robinson	NIH National Cancer Institute	1-R03-CA212720-01	1/12/17	12/31/18	Resolving the obesity paradox in kidney cancer	$99,286
Innovation	Julian	Rosenman	NIH National Cancer Institute	4-R01-CA158925-04	4/1/13	3/31/18	Integration of Endoscopic and CT data for Radiation Therapy Treatment Planning	$306,421
Theme Investment	Aziz	Sancar	NIH-National Institute of General Medical Sciences	R35-GM118102	4/1/16	3/31/21	Molecular Mechanism of Mammalian DNA Excision Repair, DNA Damage Checkpoints, and the Circadian Clock	$376,970
Theme Investment	Aziz	Sancar	NIH-National Institute of Environmental Health Sciences	R01-ES027255	8/1/16	7/31/21	Single Nucleotide Resolution Map of Formation and Repair of Bulky Adducts in the Human Genome	$187,357
Recruitment	Hanna	Sanoff	NIH National Cancer Institute	5-KO7-CA160722-05	9/1/12	8/31/16	Use and Comparative Effectiveness of Innovative Therapies for Hepatoellular Carcinoma	$170,100
Recruitment	Hanna	Sanoff	H. Lee Moffitt Cancer Center and Research Institute	MCC 17651	6/1/15	6/1/18	Multi Institutional Phase II Trial of Single Agent Regorafenib in Refractory Advanced Biliary Cancers	$200,000
Recruitment	Barbara	Savoldo	NIH National Heart, Lung, and Blood Institute	5-R01-HL114564-03-04	9/1/13	6/30/18	Enhancement of stem cell transplants using CAR.CD30-redirected T lymphocytes	$447,090
Retention	Mark	Schoenfisch	NIH National Institute of Allergy and Infectious Diseases	5-R21-AI112029-01-02	12/1/14	11/30/16	Nitric oxide-releasing cystic fibrosis therapeutics	$185,401
Retention	Mark	Schoenfisch	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	1-R01-DK108318-01	12/1/15	11/30/19	Role of diabetes and nitric oxide release duration on analytical performance of in vivo glucose biosensors	$476,433
Retention	Mark	Schoenfisch	NIH National Institute of Dental and Craniofacial Research	5-R01-DE025207-01-02	7/2/15	4/30/20	Nitric oxide-releasing dendrimers for the treatment of periodontal disease	$301,256
Innovation	Jeff	Sekelsky	NIH National Institute on Aging	5-F31-AG055157-02	6/1/16	5/31/19	FELLOW:T HATKEVICH Preventing Aneuploidy in Aging Oocytes: Investigating the effects and mechanisms of cohesion enrichment in Drosophila melanogaster.	$32,063
Innovation	Jeff	Sekelsky	NIH National Institute of General Medical Sciences	5-R35-GM118127-01-02	6/1/16	5/31/21	Mechanisms of meiotic and mitotic recombination	$520,113
Retention	Jonathan	Serody	National Inst. of Health	5-R01-HL115761-04	6/1/12	5/31/16	Targeting CCR7 for the Prevention/Treatment of GvHD	$364,450
Retention	Jonathan	Serody	NIH National Cancer Institute	4-R01-CA166794-05	5/9/12	3/31/17	Th1/Th17 Macrophage Interactions in Cutaneous GVHD	$309,342
Recruitment	Praveen	Sethupathy	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	5-F31-DK105747-02	7/1/15	6/30/18	FELLOW:BAILEY PECK Whole transcriptome analysis of distinct populations of the intestinal epithelium and its response to microbial presence	$31,321
Recruitment	Praveen	Sethupathy	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	1-R01-DK105965-01A1	12/1/15	11/30/19	Molecular and biological functions of miR-29 in lipid homeostasis	$342,000
Retention	Nicholas	Shaheen	NIH National Cancer Institute	RS506502	9/1/11	8/31/16	Barrett's Esophagus Translational Research Network (BETRNet)	$38,162
Retention	Nicholas	Shaheen	Duke University	203-6050	12/13/16	11/30/17	Imaging and Biomarkers for Early Cancer Detection (R01)	$180,261
Retention	Nicholas	Shaheen	Case Western Reserve University	RES512160	5/17/17	4/30/18	Genetic Determinants of Barrett's Esophagus and Esophageal Adenocarcinoma	$42,560
Retention	Nicholas	Shaheen	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	4-K24-DK100548-04	9/17/13	8/31/18	Non-Endoscopic Surveillance for Barrett's Esophagus Following Ablative Therapy	$180,183

Retention	Nicholas	Shaheen	National Institute of Diabetes, Digestive and Kidney Diseases	2-T35-DK007386-36	5/1/80	2/28/21	Short Term Research Training	$140,727
Retention	Norman	Sharpless	NIH National Cancer Institute	4-R01-CA163896-05	4/16/12	3/31/17	In vivo murine models of metastasis for therapeutic testing	$400,209
Retention	Norman	Sharpless	NIH National Cancer Institute	4-K12-CA120780-10	7/1/06	8/31/17	UNC Oncology Clinical Translational Research Training Program	$494,054
Retention	Norman	Sharpless	NIH National Institute on Aging	5-F32-AG050399-02	4/1/15	3/31/18	FELLOW:B DIEKMAN Defining the role of cellular senescence in osteoarthritis	$58,002
Retention	Norman	Sharpless	NIH National Cancer Institute	5-R01-CA185353-01-03	6/1/14	5/31/18	(PQD5) Predicting Anti-Cancer Efficacy through Tumor Profiling	$405,890
Retention	Norman	Sharpless	NIH National Institute on Aging	5-R01-AG024379-11-12	8/15/04	3/31/20	The Role of p16INK4a in Mammalian Aging	$335,160
Retention	Norman	Sharpless	NIH National Cancer Institute	1-R01-CA203023-01	1/12/16	12/31/20	Biomarkers of Molecular Age to Predict the Toxicity of Cancer Chemotherapy	$572,222
Retention	Dinggang	Shen	National Inst. of Health	5-R01-EB009634-04	9/1/11	8/31/16	Fast, Robust Analysis of Large Population Data	$323,010
Retention	Dinggang	Shen	NIH National Institute of Mental Health	4-R01-MH100217-04	8/26/13	5/31/17	Infant Brain Measurement and Super-Resolution Atlas Construction	$506,315
Retention	Dinggang	Shen	NIH National Institute of Biomedical Imaging and Bioengineering	5-R01-EB006733-04-07	12/1/06	8/31/17	Development and Dissemination of Robust Brain MRI Measurement Tools	$497,189
Retention	Dinggang	Shen	NIH National Institute of Biomedical Imaging and Bioengineering	5-R01-EB008374-05-06	4/1/08	1/31/19	4D Software Tools for Longitudinal Prediction of Brain Disease	$451,650
Retention	Dinggang	Shen	NIH National Institute of Biomedical Imaging and Bioengineering	1-R01-EB022880-01	9/30/16	6/30/19	Diagnosis of Alzheimer's Disease Using Dynamic High-Order Brain Networks	$380,000
Retention	Dinggang	Shen	NIH National Institute on Aging	5-R01-AG041721-04-05	4/1/12	3/31/20	Quantifying Brain Abnormality by Multimodality Neuroimage Analysis	$350,863
Retention	Dinggang	Shen	NIH National Institute on Aging	1-RF1-AG053867-01A1	9/30/16	6/30/21	Analyzing Large-Scale Neuroimaging Data in Alzheimer's Disease	$497,171
Retention	Dinggang	Shen	NIH National Cancer Institute	5-R01-CA206100-01-02	9/1/16	7/31/21	Automatic Pelvic Organ Delineation in Prostate Cancer Treatment	$347,700
Recruitment	Yen-Yu	Shih	Stanford University	61353145-115866	7/1/16	6/30/17	Circuit mapping using optogenetic fMRI	$14,420
Recruitment	Yen-Yu	Shih	NIH National Institute of Neurological Disorders and Stroke	5-R01-NS091236-01-02	5/15/15	4/30/20	Functional dissection of therapeutic deep brain stimulation circuitry	$389,880
Recruitment	Yen-yu	Shih	NIH National Institute of Mental Health	5-R01-MH111429-01-02	9/13/16	6/30/21	Chemogenetic Dissection of Neuronal and Astrocytic Compartment of the BOLD Signal	$504,390
Recruitment	Angie	Smith	Agency for Healthcare Research and Quality	1-K08-HS024134-01A1	4/1/16	3/31/19	Developing an Interactive, Patient-Centered mHealth Tool to Enhance Post-Cystectomy Care	$155,064
Recruitment	Jennifer	Smith	NIH National Cancer Institute	5-R01-CA183891-01-02	4/9/15	3/31/20	Effect of HPV Self-Collection on Cervical Cancer Screening in High Risk Women	$614,804
Innovation	John	Sondek	NIH National Institute of General Medical Sciences	5-R01-GM120291-01-02	9/15/16	7/31/20	Inhibition of GTPases and G proteins to treat human disease	$358,307
Recruitment	Lixin (Lee)	Song	NIH National Cancer Institute	1-R21-CA212516-01	12/1/16	11/30/18	Enhancing Survivorship Care Planning for Patients with Localized Prostate Cancer Using A Couple-focused Web-based Tailored Symptom Self-management Program	$198,360
Innovation	Brian	Strahl	NIH National Institute of General Medical Sciences	5-R01-GM110058-01-03	6/1/14	2/28/18	Factors that regulate chromatin organization and gene transcription	$286,204
Innovation	Brian	Strahl	NIH National Institute of General Medical Sciences	1-F31-GM122321-01	12/1/16	11/30/18	FELLOW: A. LERNER Elucidating dynamics and function of histone H3 lysine 36 methylation and demethylation using optogenetic tools	$33,867
Innovation	Til	Stürmer	NIH National Institute on Aging	2-R56-AG023178-11A1	12/1/03	2/28/17	Propensity Scores and Preventive Drug Use in the Elderly (R01 AG023178)	$411,862
Innovation	Til	Stürmer	NIH National Institute of Mental Health	1-F31-MH107085-01A1	1/1/16	12/31/17	FELLOW:BUSHNELL, G Pediatric anxiety: Pharmacotherapy and psychotherapy utilization and serious adverse outcomes	$34,281

Retention	Lishan	Su	National Inst. of Health	5-R01-DK098079-03	9/1/13	8/31/16	HIV-Hepatitis C Virus Interactions and Pathogenesis	$92,282
Innovation Award	Lishan	Su	National Inst. of Health	5-R01-AI095097-04	12/1/11	11/30/16	HIV Co-Infection and HCV-induced Liver Fibrosis in vivo	$370,000
Retention	Lishan	Su	NIH National Institute of Diabetes, Digestive, and Kidney Diseases	4-R01-DK095962-04	7/15/13	4/30/17	Novel Therapeutic Approaches to Treating Chronic Hepatitis B Virus Infection	$486,852
Recruitment	Maureen	Su	NIH National Institute of Neurological Disorders and Stroke	4-R01-NS079683-04	6/1/13	5/31/18	Autoimmune Mechanisms in a Novel Aire-deficient Model of Peripheral Neuropathy	$333,561
Retention	Lishan	Su	NIH National Institute of Allergy and Infectious Diseases	5-R01-AI127346-01-02	6/15/16	5/31/21	HIV-1 Vpr disrupts the IFN-TET-ISG pathway to promote HIV-1 infection and persistence	$350,000
Theme Investment (HTS)	Patrick	Sullivan	National Inst. of Health	2-R21-MH102814-02	7/1/14	6/30/16	The Schizophrenia Candidate Gene MIR137: functional Studies in Mouse	$190,000
Theme Investment (HTS)	Patrick	Sullivan	NIH National Institute of Mental Health	5-R01-MH077139-07-08	4/1/06	4/30/19	1/2 A Large-Scale Schizophrenia Association Study in Sweden	$223,439
Theme Investment (HTS)	Patrick	Sullivan	NIH National Institute of Mental Health	1-U01-MH109528-01	4/1/16	3/31/21	1/7 Psychiatric Genomics Consortium: Finding actionable variation	$478,788
Theme Investment (HTS)	Ronald	Swanstrom	NIH National Institute of Allergy and Infectious Diseases	2-R56-AI044667-15A1	9/1/16	8/31/17	Biological Properties of HIV-1 V3 Evolutionary Variants	$396,000
Theme Investment (CC)	Lisa	Tarantino	National Inst. of Health	5-RO1-MH100241-03	4/19/13	3/31/18	Role of Maternal diet and Allelic Imbalance in Behavior	$536,322
Innovation	Nancy	Thomas	NIH National Cancer Institute	5-R03-CA199487-01-02	7/1/15	6/30/17	TERT Promoter Mutation as a Melanoma Biomarker	$76,000
Retention	Jenny	Ting	Duke University	2035707	8/17/16	7/31/17	Testing of TLR Radiomitigator in Nonhuman Primates - Administrative Supplements to Existing NIH Grants	$273,256
Retention	Jenny	Ting	Duke University Medical Center	2034588	8/1/10	7/31/17	Inflammation and Radiation-Induced Lung Injury	$346,900
Retention	Jenny	Ting	NIH National Institute of Allergy and Infectious Diseases	4-R37-AI029564-24	7/1/91	3/31/18	Plexin-A1: Regulation by CIITA and Immunologic Function	$409,284
Retention	Jenny	Ting	NIH National Institute of Allergy and Infectious Diseases	5-U19-AI109965-01-03	3/1/14	2/28/19	Discovery of New Innate Immune Pathways in Viral Recognition	$2,863,677
Retention	Jenny	Ting	NIH National Institute of Allergy and Infectious Diseases	5-U19-AI109784-01-03	7/1/14	6/30/19	Novel Nanoparticle Platform for the Delivery of Vaccines and Adjuvants	$4,178,026
Retention	Jenny	Ting	National Inst. of Health	2-U19-AI067798-11	8/1/15	7/31/20	Innate Immune Pathways that Mitigate Delayed Radiation-Induced Damage	$346,900
Retention	Jenny	Ting	NIH National Institute of Allergy and Infectious Diseases	2-T32-AI007273-31	7/1/84	8/31/21	Basic Immune Mechanisms	$370,388
Recruitment	Melissa	Troester	NIH National Cancer Institute	5-R21-CA175783-02	9/1/13	8/31/16	HGF Signaling in African-American and Basal-like Breast Cancer	$151,040
Recruitment	Melissa	Troester	NIH National Cancer Institute	5-F31-CA200336-02	9/15/15	9/14/17	FELLOW:E BUTLER Smoking as a Proxy for Nicotine Exposure and Risk of EGFR Positive Breast Cancer	$34,449
Recruitment	Melissa	Troester	NIH National Cancer Institute	5-U01-CA179715-01-03	6/1/14	5/31/19	Biology of Race and Progression Associated Breast Tumor Gene Expression	$313,159
Recruitment	Justin	Trogdon	Centers for Disease Control (Subcontract with Research Triangle Institute)		6/9/15	9/30/16	The Medical Costs Attributable to Breast Cancer for Younger Women	$24,311

Recruitment	Justin	Trogdon	NIH National Institute on Aging	1-R01-AG050733-01A1	9/1/16	5/31/19	Cancer, Care Coordination, and Medication Use for Multiple Chronic Conditions	$218,120
Recruitment	William	Valdar	NIH National Institute of General Medical Sciences	4-R01-GM104125-05	9/30/12	8/31/17	Statistical Modeling of Complex Traits in Genetic Reference Super-Populations	$241,086
Recruitment	William	Valdar	University of Colorado Denver	FY17.878.001/ PO1000836258	2/17/17	11/30/17	The interplay between genes and environment on cardiovascular disease phenotypes	$43,858
Recruitment	William	Valdar	NIH National Institute of Mental Health	5-F30-MH108265-02	8/1/16	7/31/19	FELLOW:CORTY, R Statistical modeling of genetic effects on behavior and its variability	$39,548
Recruitment	William	Valdar	NIH National Institute of Mental Health	1-F30-MH108265-01A1	8/1/16	7/31/19	Statistical modeling of genetic effects on behavior and its variability	$34,217
Recruitment	Carmina	Valle	NIH National Cancer Institute	1-R01-CA204965-01A1	2/7/17	1/31/21	Promoting Physical Activity in Young Adult Cancer Survivors Using mHealth and Adaptive Tailored Feedback Strategies	$584,465
Recruitment	David	Van Duin	Case Western Reserve University	RES510308	6/25/15	5/31/17	Molecular Epidemiology of Carbapenem Resistant Klebsiella pneumoniae	$75,816
Recruitment	David	Van Duin	Duke University	207574/215728	6/6/16	8/31/19	Prospective Observational Study of the Risk Factors for Hospital-Acquired and Ventilator-Associated Bacterial Pneumonia (HABP/VABP)	$60,752
Recruitment	David	Van Duin	Rutgers the State University of New Jersey	8316	12/16/16	11/30/21	The molecular basis of the carbapenem resistance epidemic	$18,555
Recruitment	Cyrus	Vaziri	Department of Defense - ended 9/29/16	W81XWH-14-1-0428	6/1/14	5/31/16	Exploiting Tumor-Activated Testes Proteins to Enhance Efficacy of First-Line Chemotherapeutics in NSCLC - Subcontract with University of Texas Southwetern Medical Center	$87,500
Recruitment	Cyrus	Vaziri	National Inst. of Health	1-R21-ES023895-02	9/19/14	8/31/16	Novel Rad18 functions in Histone Modification and Regulation of Gene Expression	$157,500
Recruitment	Cyrus	Vaziri	NIH National Institute of Environmental Health Sciences (NIEHS)	4-R01-ES009558-20	8/1/98	4/30/17	A Novel Carcinogen-Induced Cell Cycle Checkpoint	$333,000
Recruitment	Cyrus	Vaziri	NIH National Institute of General Medical Sciences	5-R01-GM105883-01-03	1/1/14	11/30/17	Targeting the TLS DNA Damage Tolerance Pathway for Cancer Therapy	$286,392
Recruitment	Yisong	Wan	NIH National Institute of Allergy and Infectious Diseases	4-R01-AI097392-05	5/1/12	4/30/17	The Roles of Gata3 in Controlling Treg Function	$368,389
Recruitment	Yisong	Wan	NIH National Institute of Allergy and Infectious Diseases	1-R01-AI123193-01A1	12/12/16	11/30/21	Functional protein networks underlying T cell growth, proliferation and differentiation	$377,975
Recruitment	Gang (Greg)	Wang	Department of Defense - end date 7/14/17	W81XWH-14-1-0232	7/15/14	6/30/16	Epigenetic Therapy of Hematopoietic Malignancies: Novel Approaches for Tissue-Specific and Global Inhibition of EZH2 Enzymatic Activities	$158,312
Recruitment	Andrew	Wang	NIH National Cancer Institute	5-R21-CA182322-03	9/19/13	8/31/16	Development of 3D Organ-Specific Models of Colorectal Cancer Metastasis	$260,571
Recruitment	Andrew	Wang	Stanford University	61399862-117724	9/1/16	7/31/17	Self-assembling nanoparticles at tumor sites to enhance and amplify radiotherapeutic effects	$35,714
Recruitment	Andrew	Wang	NIH National Cancer Institute	4-R01-CA178748-04	8/15/13	5/31/18	Nanoparticle formulations of DNA repair inhibitors to improve chemoradiotherapy	$312,079
Recruitment	Andrew	Wang	DOD DA Army Medical Research Acquisition Activity	W81XWH-16-1-0530	9/1/16	8/31/18	Tissue Engineered Cancer Metastasis to Improve the Abscopal Effect and Cancer Immunotherapy in Melanoma.	$302,567
Recruitment	Greg	Wang	NIH National Cancer Institute	1-R01-CA211336-01	2/1/17	1/31/22	Cancer Epigenetics: A Novel PRC2 Dysregulation Mechanism in Multiple Myeloma	$403,643
Recruitment	Greg	Wang	NIH National Cancer Institute	1-R01-CA215284-01	4/1/17	3/31/22	Determining the Role of DNA Methylation Deregulation in Oncogenesis	$348,584

Innovation Award	Marcey	Waters	NIH National Institute of General Medical Sciences	5-R01-GM110017-01-02	8/15/16	7/31/20	Investigation of Latent Free Energy in Noncovalent Networks	$365,536
Theme Investment (CC)	Jason	Whitmire	National Inst. of Health	1-R21-AI117575-01	7/1/15	6/30/17	Genetic & Mechanistic Dissection of a Lethal Systemic Virus Infection	$190,000
Recruitment	Scott	Williams	NIH National Institute of General Medical Sciences	5-R01-GM098264-03-06	5/1/12	4/30/17	Structural and functional diversity of the methyl-binding domain protein family	$284,726
Recruitment	Scott	Williams	NIH National Institute of Dental and Craniofacial Research	5-R21-DE025725-01-02	9/5/16	8/31/18	Illuminating the Role of Oral Stem Cells in the Development of Oral Squamous Cell Carcinomas	$228,000
Recruitment	Scott	Williams	NIH National Institute of Dental and Craniofacial Research	1-F31-DE026956-01	3/1/17	2/28/19	FELLOW: KENDALL LOUGH Cell-cell adhesion in regulation of mammalian palatogenesis	$32,743
Recruitment	Scott	Williams	NIH National Institute of Dental and Craniofacial Research	1-K08-DE026537-01	9/12/16	8/31/21	Mechanisms of Oral Epithelial Differentiation	$89,580
Theme Investment	Tm	Wiltshire	NIH National Institute of Environmental Health Sciences	NIH/NIEHS-U01ES026717 01	6/1/16	4/30/20	System Toxicogenomics of Endocrine Disrupting Chemicals in Brain	$477,237
Recruitment	William	Wood	NIH National Cancer Institute	5-R21-CA192127-01-02	7/1/15	6/30/17	Exercise in Cancer Survivors Before Allogeneic Stem Cell Transplanation	$177,650
Recruitment	William	Wood	Mayo Clinic	NOR-194321	8/1/14	7/31/17	Assessing Physical Fitness in Cancer Patients with Cardiopulmonary Exercise Testing and Wearable Data Generation: An Alliance Pilot Study Proposal	$50,000
Innovation	Yue	Xiong	NIH National Cancer Institute	4-R01-CA163834-05	3/1/12	2/28/17	Mechanisms of Metabolic Gene Mutations in Cancer	$307,100
Recruitment	Yang	Yang	National Inst. of Health	5-K01-AG036745-05	8/1/10	7/31/16	Sex Differences in Health and Longevity: A Social and Biodemographic Approach	$120,339
Retention	Jen Jen	Yeh	Princeton University	SUB0000166	9/15/16	8/31/17	Pathway and Network Integration of Cancer Genomics and Clinical Data	$91,000
Retention	Jen Jen	Yeh	University of Rochester	416909-G	9/1/16	8/31/19	Targeting macrophages to improve chemotherapy in metastatic pancreas cancer	$126,248
Retention	Jen Jen	Yeh	NIH National Cancer Institute	5-R01-CA193650-01-02	5/1/15	7/31/20	The adaptive kinome in pancreatic cancer	$570,696
Retention	Jen Jen	Yeh	NIH National Cancer Institute	1-R01-CA199064-01A1	8/1/16	7/30/21	Tumor subtypes and therapy response in pancreatic cancer	$227,555
Recruitment	Qing	Zhang	NIH National Cancer Institute	5-ROO-CA160351-05	2/1/13	6/30/16	Role of the EgIN2 Target FOXO3a in Breast Cancer	$241,530
Retention	Yanping	Zhang	NIH National Cancer Institute	4-R01-CA155235-05	7/1/12	4/30/17	Mitochondrial p32 regulation of the Mdm2-p53 tumor suppression signaling and apoptotic cell death	$307,100
Retention	Yanping	Zhang	NIH National Cancer Institute	4-R01-CA167637-05	9/1/12	6/30/17	The in vivo role of the Mdm2-MdmX interaction in p53 regulation	$305,832
Retention	Qisheng	Zhang	National Institute of General Medical Sciences	5-R01-GM086558-01-05	9/1/11	8/31/17	Development of Small Molecule ARFGAP Regulators to Dissect Cell Signaling	$277,866
Recruitment	Qing	Zhang	DOD DA Army Medical Research Acquisition Activity	W81XWH-15-1-0599	9/30/15	9/29/18	Validation of ZHX2 as a Novel pVHL E3 Ligase Substrate and Its Role in Kidney Cancer	$179,307
Recruitment	Qing	Zhang	Department of Defense	W81XWH-17-1-0016	1/15/17	1/14/20	FDXR Regulates ER Positive Breast Tumorigenesis via Reprogramming Metabolism	$427,169
Recruitment	Qing	Zhang	NIH National Institute of General Medical Sciences	5-R01-GM114432-01-02	5/1/15	4/30/20	Riboswitch and Ribozyme Dynamics at Atomic Resolution	$285,918
Recruitment	Qing	Zhang	National Science Foundation	MCB-1652676	2/15/17	1/31/22	CAREER: RNA conformational dynamics in the regulation of microRNA biogenesis	$197,487
Theme Investment (CC)	Fei	Zou	National Inst. of Health	5-R01-GM074175-08	7/1/11	8/31/16	Robust Methods for Complex Trait Association Mapping with Collaborative Cross	$222,740