

The title text is overlaid on a stylized, light orange map of North Carolina. The map has a slightly distressed or torn-edge appearance.

University Cancer Research Fund

**Annual Financial Report to the Joint Legislative
Education Oversight Committee and the Office of
State Budget and Management**

Submitted November 1, 2013
in accordance with G.S. 116-29.1

University Cancer Research Fund

A Message from the Chair

Since nearly 40 percent of North Carolinians are affected by cancer during their lives, improving prevention, treatment and results is critical to our state's public and economic health. Thanks to the General Assembly's support, the University Cancer Research Fund (UCRF) has helped make the UNC-Chapel Hill a national leader in the fight against this disease.

As Chair of the Cancer Research Fund Committee, I am pleased to present this annual legislative report, which details the growing economic impact the UCRF has had for North Carolina. The report also outlines investments in groundbreaking research that will help give cancer patients more effective therapies, better outcomes and more hope for the future. The UCRF has produced many positive returns for North Carolina, including:

- Hiring and retaining 149 outstanding cancer researchers at UNC;
- Publishing high-impact research findings in the world's top journals.
- Continuing increases in research funding directly attributable to UCRF investment. This year alone, UNC received \$105.8 million in new research funding from outside North Carolina, thanks to the UCRF;
- Enhancing spin-off commercialization efforts and intellectual property, adding new innovations to the nation's third-largest cluster of life science industries;
- Maintaining a significant annual economic impact for North Carolina – \$264.8 million for fiscal 2012-2013 and more than 1,900 new jobs. That adds up to a return of slightly more than five dollars for every dollar invested;
- Advancing large-scale projects designed to better understand the cancer problems in North Carolina from the genetic to the community level, and participating in global collaborations aimed at eradicating this disease.

Each year, almost 50,000 North Carolinians are diagnosed with cancer and more than 18,000 die from the disease. Because cancer care has many different aspects, collaboration across several medical disciplines has been vital to our research efforts. One of our most important collaborators is the State of North Carolina, which has made it a priority to invest in efforts to eradicate our state's leading cause of death. On behalf of the thousands of families in our state affected by cancer, thank you again for your ongoing support for the UCRF.

Sincerely,



Carol L. Folt, Ph.D.
Chair, Cancer Research Fund Committee

EXECUTIVE SUMMARY

Cancer became North Carolina's leading cause of death in 2007. That year, the General Assembly created the University Cancer Research Fund (UCRF) to support the fight against a disease that claims the lives of more than 18,000 North Carolinians every year.

In 2007 the legislature determined that the state should provide \$50 million a year for cancer research under UNC Hospitals, the UNC Lineberger Cancer Center, or both. Supported by tobacco settlement funds, taxes on non-cigarette tobacco products (such as snuff), and state appropriations, the Fund first received \$25 million in 2007 and \$40 million in 2008 before reaching its full funding amount of \$50 million in 2009. In 2013, the legislature reduced the UCRF to \$42 million annually by eliminating the tobacco settlement funds as a source of UCRF support.

The legislature established the Cancer Research Fund Committee to ensure that UCRF funds are invested responsibly. In 2009, this committee, led by then-Chairman Erskine Bowles, former UNC President, adopted a Strategic Plan to focus UCRF resources on areas where they can have maximum impact. The plan calls for funds to be invested in the following manner:

- Strategic research priorities in **genetics, therapies, and NC cancer outcomes**;
- Selective **opportunities** that enable researchers to adapt to a rapidly changing field; and
- Clinical research and scientific **infrastructure** for technology development, training, and state outreach.

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

Our third financial report submitted under this requirement demonstrates that the UCRF continues to have a significant and positive economic impact on the state of North Carolina. According to an independent analysis by a nationally recognized consulting firm, in FY 2012-2013, the UCRF:

- Directly supported portions of nearly 1,000 employees;
- Created the equivalent of more than 900 new jobs;
- Had an overall economic impact of \$264.8 million, leading to an estimated six-year total impact of more than \$1.2 billion; and
- Produced a return on investment of 5.3 to 1.

UCRF has been particularly effective in one key area of economic impact: increasing funds from outside the state brought to North Carolina for cancer research. This funding growth is due to the world-class faculty members who have been recruited or retained using UCRF funding, and innovation opportunities specifically developed by the fund.

- In the current year, \$105.8 million in extramural funding is directly linked to faculty who were recruited or retained by UCRF funds, or to the results of innovation grants, technology, and infrastructure investments by UCRF.
- UCRF has helped spark a significant increase in UNC's federal funding compared to other universities, at a time when overall federal funding levels are falling.

Some economic and health outcomes of the UCRF are immediate and measurable, but the long-term effects of this research on the overall health of North Carolinians will only be appreciable in the coming years. In the meantime, the Strategic Plan has guided UCRF investments that have helped make UNC a national leader in several areas of cancer research and care. Some of the research highlights include the following:

Understanding the Role of Genetics in Cancer Causation and Treatment

UNC is now a global leader in cancer genomics, thanks to important UCRF investments in critical resources such as high-content data storage, sequencing technology, bioinformatics, statistical genetics, and genetically engineered mouse models.

- The Next Generation sequencing and analysis infrastructure built by UCRF continues to yield groundbreaking findings, international recognition for UNC, and increased extramural funding. Continued leadership of the National Cancer Institute Cancer Genome Atlas project led to a fourth paper in *Nature*, one of the nation's leading science journals, on kidney cancer, following three *Nature* publications on breast, lung, and colon cancer. Fifth and sixth papers, on head and neck cancer and melanoma, are being prepared.
- Two UCRF-supported cancer genetics faculty have been joined by a third, recently UCRF-recruited pediatric cancer geneticist, who studies cancer predisposition genes. This group, relying on the UCRF sequencing and genomics infrastructure, has obtained four new major grants totaling over \$20 million for the next five years. These projects enlarge our program in germline sequencing and analysis, putting UNC on par with any university in the world. One of these, the NCGENES grant, sequences the total expressed human genome and packages this large amount of genetic data much more effectively. With these data, doctors may develop individualized treatment plans based on a patient's genetic information, paving the way toward more personalized medicine. The newest grant pairs UNC with Stanford and Baylor to develop the national database for analyzing all genetic variants sequenced by National Institute of Health and other projects.
- Researchers innovatively used mouse models to test genetic theories about disease development, leading to a high-impact study published in *Cell*, another of the nation's leading biomedical science journals, and to new findings of how genetic mutations and dysregulation of gene expression, as well as aging and other factors, may influence tumor growth in humans.

Developing Novel Therapeutics

The continued development of our mouse models, as well as the refinement of a UNC-developed proteomic technology, have allowed researchers to work within academia and with private-sector partners to test potential new therapies targeting tumor cells. This unit can rapidly test combinations of new drugs plus standard chemotherapy to search for more effective, less toxic regimens.

- A novel "humanized" mouse model with a human immune system and human liver cells for the first time allows study of how human hepatitis virus leads to liver cancer and how it might be treated or prevented.

- Collaborative research on whether anti-obesity drugs affect the way cancer cells react to therapy will lead to important new ideas on how obesity and nutrition influence tumor development and therapeutic response.
- A drug developed by the UCRF-supported chemical biology group is showing promising results in models of pediatric leukemia and adult melanoma.
- A new kind of CT scan created with UCRF support produces higher resolution with more precision and speed; the prototype is being readied for human trials, which could result in this CT technology being the preferred method for small tumor early detection.

Optimizing NC Cancer Outcomes

Improving cancer outcomes entails many facets of cancer research – from finding new ways to reduce cancer risks, to improving screening and subsequent referral for care, getting clinical trials into the community, enhancing the life of cancer survivors, and helping patients use their voice to improve their care. UNC researchers are pursuing noteworthy studies and building capacity in the field of patient-reported outcomes during and after treatment, a field of growing importance.

- Smoking is the single major cause of cancer death, and cigars, cigarettes and new methods of smoking are being marketed to teenagers and others. With the leadership of UCRF faculty, UNC recently received a new federal grant totaling \$20 million over the next five years to establish a national center focusing on tobacco regulations and research. A second \$20 million tobacco center grant is a collaboration with UCRF faculty and will measure the impact of new forms of smoking on lung lining cells. Questions being researched include the mechanism of lung cell destruction by new tobacco products, and how marketing small cigars affects teen smoking.
- Community-based outreach through Health-e-NC continues to yield promising results that could be more widely applicable to cancer outcomes statewide. For example, a pilot project in Concord/ Kannapolis is testing cost-effective weight loss strategies.
- Our N.C. Integrated Cancer Information Surveillance System (ICISS), developed by UCRF, gives researchers the most up-to-date state-focused data-rich resource to study cancer outcomes in the country. With ICISS data support, UCRF faculty have published more than 25 new studies in high impact journals such as *JAMA*, one of the nation’s leading medical journals.

Clinical Excellence and Infrastructure

UCRF is complemented by two key capital investments that have enhanced cancer research and care in North Carolina:

- The Imaging Research Building opens January 2014, an important milestone that will greatly enhance our research efforts in drug development, nanotechnology, imaging research, and cancer biology. More than half the researchers who move into the new building will have been UCRF supported. The facility, funded by the General Assembly in 2009, will house state-of-the-art research labs and imaging equipment – some technologies available in only a few other places in the world – to help accelerate all aspects of early detection and therapy, including the discovery and testing of new cancer treatments.

- The N.C. Cancer Hospital, opened in 2009, continues to provide care for patients from all 100 counties, serving as the clinical home of the UNC Lineberger Comprehensive Cancer Center.

An important part of our mission is caring for people from all corners of our state. UCRF has helped UNC expand its clinical research network and telemedicine program, both of which enable patients to be seen by doctors close to home, yet still participate in – and benefit from – the latest advances in cancer care. Doctors across the state use the telemedicine infrastructure weekly to ask questions specific to their patients and obtain information that helps them provide state-of-the-art care.

- The telemedicine program has expanded to 42 sites in 20 North Carolina communities, linking oncologists with educational and patient-related conferences.

Summary

The University Cancer Research Fund has been a landmark investment in our state. From the economic benefits it has brought to North Carolina to its importance in strengthening our clinical and research programs, it is an investment whose gains will keep growing as UNC continues to push forward as a national leader in the fight against cancer.

ECONOMIC IMPACT

The UCRF Strategic Plan dictates that resources should be invested in a manner that helps create jobs and enhances North Carolina's economy. The Fund's economic return to our state has grown each year, exceeding a 5-to-1 return on investment in 2013. The UCRF has directly supported thousands of faculty and staff jobs, has led to vital capital investments, and has enhanced the university's research capacity and national standing. Fueled by UCRF support, UNC's rise into the top ten in National Institute of Health biomedical research funding has national impact and draws industry to North Carolina. Additional state economic benefits attributable to the UCRF include an increase in intellectual property, private-sector partnerships, spinoff and commercialization opportunities, and funding support from outside North Carolina.

Estimated Impact

To assess whether UCRF is achieving its goal of stimulating the economy, this past year UNC hired Tripp Umbach, a nationally respected consulting firm, to estimate UCRF's economic impact for FY 2013. Using a methodology similar to prior analyses, Tripp Umbach examined 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 economic impacts. Direct impact resulted from two major sources: expenditures from UCRF itself and 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 2013, UCRF's total allocation (adjusted for tax receipt shortfalls) was \$49.6 million. Using standard multipliers, Tripp Umbach estimated that in FY 2013 UCRF:

- Had an overall economic impact of \$264.8 million. The total included \$155.8 million in direct spending and \$109.0 million in indirect and induced impact attributable to external grant funding;
- Generated \$5.30 in economic impact for every UCRF dollar expended;

- Supported 1,919 new jobs; and
- Resulted in nearly \$7.6 million in tax revenues to the North Carolina.

Using slightly different methodology, prior economic impact analyses by SRA International and the UNC Center for Competitive Economies (Frank Hawkins Kenan Institute of Private Enterprise) found that between FY 2008 and FY 2012, UCRF's cumulative economic impact was \$968.0 million over the Funds' first five years. The FY13 total brings the economic impact of UCRF over its entire six year span to more than \$1.2 billion.

Faculty Job Creation and Retention

Faculty drive the UCRF. They lead the teams that conduct the groundbreaking research to push the boundaries of our knowledge and advance cancer treatment, prevention and early detection. Faculty also hire staff, evaluate technology, earn research funding from outside North Carolina, and train students and fellows. UCRF has had a tremendous positive impact on cancer research faculty at UNC during the six years from 2007 - 2013:

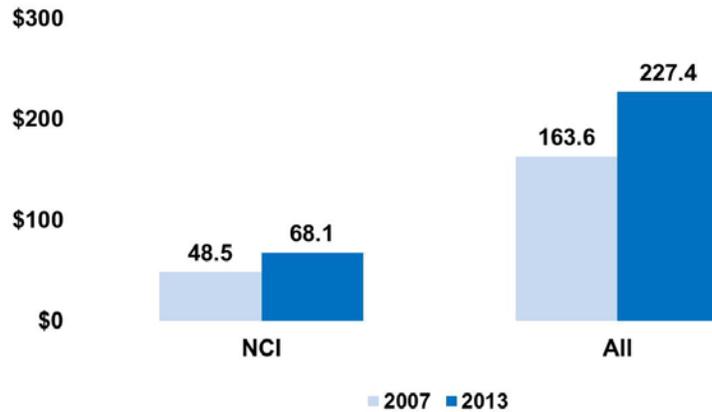
- **Recruitment:** UCRF has supported the recruitment of 126 faculty in the College of Arts and Sciences, the Schools of Nursing, Public Health, Medicine, Pharmacy and Journalism and Mass Communication. These faculty are developing a wide range of research programs in nanomedicine, quantitative biology, cancer genomics, health outcomes, health communications, multiple cancer types, and other areas critical to improving cancer prevention, diagnosis and treatment in our state.
- **Retention:** UCRF support has led to the retention of 23 faculty

Extramural Funding Growth

Virtually all extramural funds come to UNC from outside North Carolina and add to the state's economy. The UCRF Strategic Plan establishes extramural research funding – particularly competitive federal funding – as a key metric for UCRF success. According to this metric, UCRF funds are being invested very effectively. UCRF support is leveraging extramural research funds for North Carolina at a time when national funding levels are decreasing, keeping the state at the forefront of research nationally. Key trends include the following:

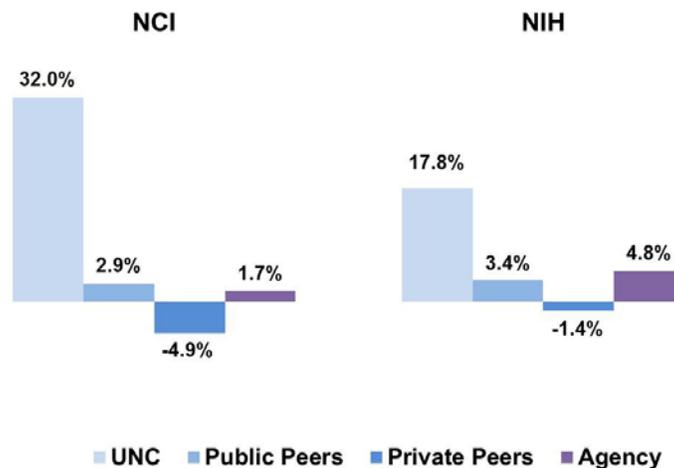
- FY 2013 funding from outside sources that is directly attributable to the UCRF totaled \$105.8 million in annual total cost dollars.
 - This amount is based on a snapshot of active attributable extramural funding held by faculty in the first quarter of FY 2013-2014. The dollars represent one year of funding. A complete list of the awards is included in the Appendix.
 - The attributable extramural funding has risen from \$5 million in 2007-2008, as the positive effects of faculty recruitment and retention, technology enhancement, and developmental projects have accumulated. Many of the currently active awards will continue for several more years, and we fully expect new awards to add to the total.
- Between 2007 and 2013, extramural support to the UNC Lineberger Comprehensive Cancer Center increased from \$163.6 million to \$227.4 million; support from the National Cancer Institute grew from \$48.5 million to \$68.1 million.

Growth in UNC Lineberger Extramural Funds (\$ millions)



- The National Institutes of Health (NIH) and the National Cancer Institute (one of the NIH institutes) increased awards to UNC Chapel Hill faculty between FY 2007 and FY 2012, while awards to many comparable institutions decreased during that time period.
 - NIH awards to UNC Chapel Hill increased by almost 17.8 percent, significantly ahead of public peer institutions (3.4% increase), private peer (1.4% decrease), and total agency extramural awards (4.8% increase). Peers were independently chosen by SRA.
 - NCI awards to UNC Chapel Hill increased 32%, significantly ahead of public peers (2.9% increase), private peers (4.9% decrease), and total agency extramural awards (1.7% increase). Peers are the same as for the NIH funding analysis.

NCI and NIH Funding Trends FY 2007- FY 2012 UNC vs. Peers



- o UNC Chapel Hill has outperformed many of the nation’s leading academic research institutions. In 2007, UNC Chapel Hill ranked 11th in NIH and 14th in NCI award funding. Between FY 2007 and FY 2012, UNC Chapel Hill’s NIH and NCI funding grew by 17.8% and 32.0%, while, as a group, the other members of the 2007 top 20 funded institutions had increases of only 7.8% and 2.3%. As a result, in FY 2012 UNC Chapel Hill ranked 9th in NIH awards and 11th in NCI awards.

Intellectual Property, Innovation, and Entrepreneurship

The UCRF focus on innovation has promoted entrepreneurship that has created jobs and spinoff companies:

- **NC Kickstart:** The UCRF, in collaboration with UNC’s TraCS Institute, is developing an entrepreneurial mindset at UNC. UCRF supports specialized staff to maximize the development and licensing of university intellectual property. In the past six years, 18 startup companies have been launched or expanded their scope with direct UCRF help. These new companies are attracting external grant support and venture capital investment, as well as creating private-sector jobs.

Spinoff Companies Supported by UCRF	
BioFluidica	KynoDyn
ChemoGlo	Liquidia Technologies
Clave BioDesign	Meryx
ClinicalStandards.com	NanoGlo
Enci Therapeutics, Inc.	NeuroNano Pharma
Epizyme	NextRay
G1 Therapeutics	Qualiber
GeneCentric Diagnostics	Syberix
HealthSpan Diagnostics	XinNano Material, Inc.

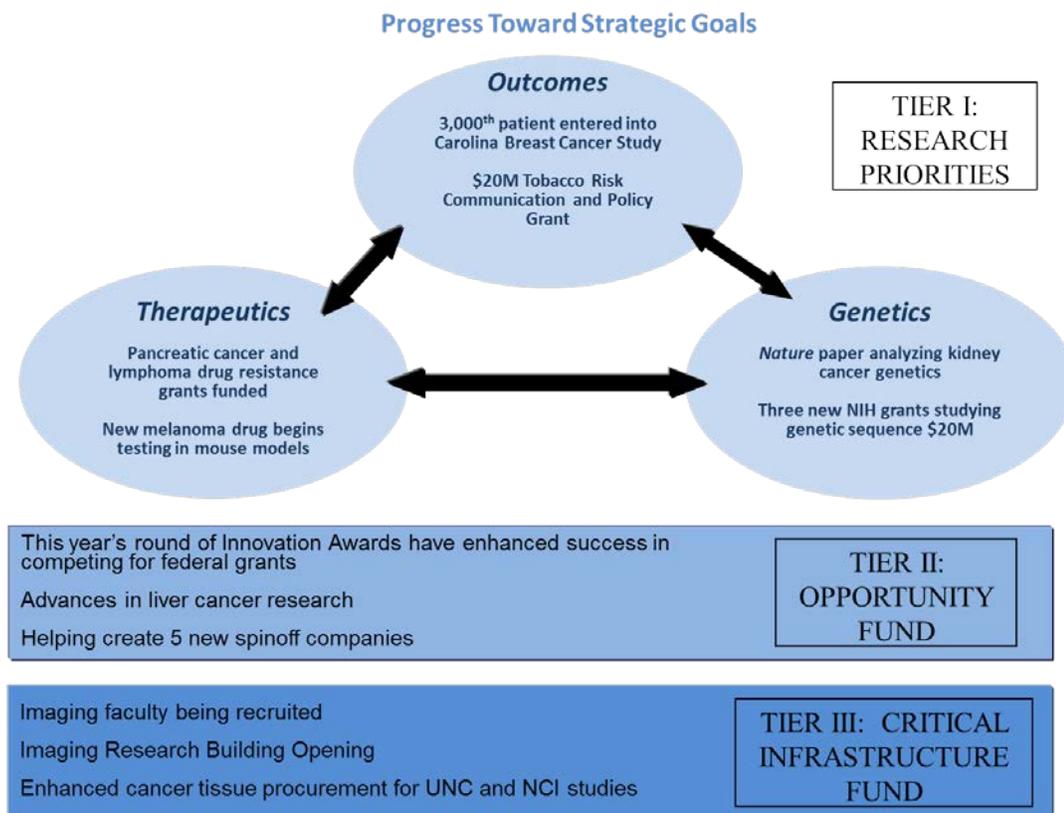
RESEARCH OUTCOMES

The UNC Lineberger Comprehensive Cancer Center received an “exceptional” rating from the National Cancer Institute – a rating NCI has given to only six of the nation’s 40 recently reviewed cancer centers. NCI cited the University Cancer Research Fund as a significant reason UNC earned the Institute’s highest ranking.

The UCRF Strategic Plan encompasses three primary tiers of effective and responsible use of the state’s investment: Research Priorities, the Opportunity Fund, and Critical Infrastructure. This section of our report highlights noteworthy successes in each tier.

- 1) **Research Priorities:** Three targeted research priority areas 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 cancer patients to poor treatment outcomes – particularly by looking for the mutant genes in specific cancer subtypes that lead to cancer therapy failure.

- **Developing Novel Therapeutics** – to devise new therapies targeted to the specific vulnerabilities of treatment-resistant cancers, and to develop new ways of delivering drugs and therapies to reduce toxic side effects for patients. This research priority relates to the genetics initiative, making key observations that will be turned into clinical applications as quickly as possible.
 - **Optimizing NC Cancer Outcomes** – to build population-based data tracking the occurrence and treatment of cancer across the state in order to support research aimed at improving community prevention and early detection, and to enhance the quality of oncology and survivor care. Our goal is to understand North Carolina’s cancer problem at a level unprecedented in the nation and to design research interventions to rectify these problems at the community, health system, and practice levels.
- 2) **Opportunity Fund:** Allows UCRF to remain nimble, seizing research or clinical opportunities as they arise and providing the top minds in the field with the resources they need. Examples include competitive, innovative pilot projects; seed funds to recruit top researchers; support of leading-edge technology and equipment for use by multiple faculty members; and the development of shared research resources.
- 3) **Critical Infrastructure Fund:** Provides critical resources for cancer research that are not readily obtainable by outside funding but upon which future progress relies. Investing in imaging, informatics and fundamental research techniques ultimately provides clinician scientists with the tools to change patient outcomes. To do this requires enhancement of multidisciplinary excellence in cancer care and the development of a statewide infrastructure to help bring leading-edge clinical research and applications into community practices.



Research Priority 1: Understanding the Role of Genetics

The presence and mutation of certain genes play a critical role in the development and treatment of cancer. Genetics influence how much risk a person or a family have of getting cancer, how cancer treatments affect certain tumors, and how well a cancer patient responds to care. The gene mutations in a patient's tumor can help doctors predict the development of disease and choose the correct course of treatment. Cancer genetics, from basic work in mice to analysis of human cancer samples, is a fast-growing field. The results of these studies are in early detection, treatment, prevention and prognosis. UCRF investments have helped UNC take a national leadership role in this important area of research.

Illuminating the link between aging and cancer



Using UCRF infrastructure, UNC researchers led by Dr. Ned Sharpless, MD – who will become director of the UNC Lineberger Comprehensive Cancer Center on January 1, 2014 – have developed a new way to study aging and tumor growth in mice by using a gene from fireflies to make affected mouse cells glow.

A gene called p16 plays a role in aging and cancer suppression by activating a tumor defense mechanism called cellular senescence. The loss of this gene is seen in some families predisposed to melanoma, and most lung cancers have mutations that delete the p16 tumor suppressor pathway. In a study published in *Cell*, one of the world's highest impact journals, the group inserted a firefly gene into lab mice, creating a strain of mouse that glows in the dark when the p16 gene is activated. Everywhere the p16 gene is activated due to senescence signaling, the firefly gene is activated, causing the affected tissue to glow.

“We can visualize in real-time the activation of cellular senescence, which on the one hand serves to prevent cancer but on the other hand leads to aging of the cell or organ. We can literally see the earliest molecular stages of cancer and aging in living mice,” Sharpless said.

Throughout the lifespan of these mice, they tracked the brightness and location of the glowing in each mouse to study p16 activation. Old mice were brighter than young mice, and sites of cancer formation were extremely bright because the new cancer forming cell activates senescence to prevent that specific cell from growing. This novel strain of mice has been distributed to more than 40 other research labs in the US, Europe and Japan, and researchers are using the glowing mice to test factors that promote aging, to identify nascent cancer development so that it can be studied in its earliest stages, and to study the response of tumors to early anti-cancer treatments.

Using what we learn from mice for human p16 studies

UNC researchers are applying what they have learned about p16 and cell aging to examine cancer treatment in humans, specifically studying whether p16 levels in white blood cells, which track “biologic age” of a patient rather than chronologic age, can help predict how they will respond to cancer therapy. The expression of the p16 gene has been measured in more than 1,000 patients undergoing cancer therapy at UNC; scientists hope to develop more effective and tolerable patient treatment schemes based upon the patient's cellular age rather than their chronological age. The test could eventually predict an individual's best treatment option, particularly for those in the 55 - 75 year-old age range. It can also potentially tell how cancer treatment will “age” the patient. Two UCRF

recruits, Drs. Hy Muss and Hanna Sanoff, are leading the clinical study in breast cancer, colon cancer, and other patients.

NCGENES team rises to national leadership



Jim Evans

The UCRF investment in cancer genetics has built a world class technological and computational base for human cancer genetics. It was also used to retain its nationally recognized leader, Jim Evans, and to recruit two new faculty, Jonathan Berg and Bradford Powell, from Baylor.



Jonathan Berg



Bradford Powell

The cancer genetics group was recently awarded four large NIH grants, totaling more than \$4M yearly, to sequence

patient and newborn genomes and to be the national center joined with Stanford to catalogue all human genetic variation.

Sequencing the first human genome took over a decade, but is now accomplished on a daily basis at UNC and other major gene sequencing centers. This amazing increase in sequencing capacity has produced a significant new challenge for doctors, researchers and patient: determining how to use this wealth of data to improve human health. A UCRF-initiated project called NCGENES (North Carolina Clinical Genomic Evaluation by NextGen Exome Sequencing) aims to help researchers and clinicians diagnose genetically caused diseases, pinpoint people at high risk for diseases before they show symptoms, and guide new disease treatments.

The goal of this collaborative project is to develop processes and a supporting cyber infrastructure that will allow researchers, clinicians and patients to take full advantage of whole genome sequencing; it also includes whole exome sequencing, which applies to the full set of exons, or protein-coding parts, of the genome. Researchers hope that by studying the variants in peoples' genes they will better understand observable characteristics and conditions. Ultimately, NCGENES could represent a major step toward more personalized medicine.



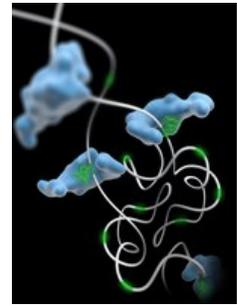
Christine Rini

About 750 patients from UNC hospitals and clinics will have their genomes sequenced and analyzed through NCGENES. The study will enroll undiagnosed patients with potential genetic predisposition to disease. NCGENES could potentially reveal genetic information having lifelong impacts on the study subjects, so all patients participating in the study will receive education about the implications of their genome analysis. One arm of the study will examine how patients respond to potentially troubling genetic findings by asking some study participants to choose whether they want to receive incidental findings about untreatable conditions. Researchers will gather data on what people want (and

don't want) to know about their genetics, what factors influence their decisions, and how information about genetic diseases changes peoples' attitudes and behaviors. UCRF recruit Chris Rini, PhD, is designing the patient interaction and assessment aspects for this transdisciplinary team.

Research shows RNA is vital to disease development

Genetic flow is from DNA to RNA to protein, and for years RNA was considered just an intermediary. Now that we know that greater than 80 percent of the RNA encoded in the human genome does not turn into protein, cancer researchers are working to discern the function of this mass of non-coding RNAs. Most of these RNA molecules function correctly when they fold into a three-dimensional shape. In part using UCRF RNA sequencing machines, UNC Lineberger member Dr. Kevin Weeks, Kenan Distinguished Professor of Chemistry, published an important study this spring in *Science* examining how helper molecules, or “chaperones,” aid in the RNA folding process. These chaperones have wide-ranging effects – they can cause some RNAs to interact more quickly, influence other RNAs to change their forms, and even work simultaneously over large distances. In the *Science* study, Dr. Weeks’s lab found that chaperones target RNAs’ base pairs, which are stabilized by three hydrogen bonds instead of two, and weaken those pairs to facilitate the folding process. The discovery of this weakening process provide clues as to how RNA may perform actual work in the cell or be used to add on the complete layer of regulation needed to understand to grasp the molecular nature of cancer. This fundamental observation is helping understand the new RNA world.



SUCCESS STORY: Breast cancer lab test based on Perou’s discovery gains FDA approval



A molecular laboratory test that estimates the risk of breast cancer relapse in spite of anti-hormone treatment has received approval from the U.S. Food and Drug Administration (FDA). UCRF genomics technology, computational capacity and recruitment of bioinformatics faculty (e.g., Joel Parker, PhD), was used to devise the test and develop the gene signature known as “PAM50.” Led by Dr. Chuck Perou, these groundbreaking studies of gene expression in breast cancer are changing the world’s view and treatment of breast cancer.

Genomic and genetic tests are increasingly important in cancer treatment, Perou said. “These tests are a major step down the road towards personalized medicine, and our approach allows us to make this test available to a global market,” he said.

The test, called Prosigna™ and developed by NanoString Technologies in a collaboration between UNC and Washington University in St. Louis, the University of Utah, and the BC Cancer Agency, relies on new technology in the form of a third generation machine and a test kit. For the first time, patient tumor samples can be analyzed at centers around the country rather than being sent to one central testing laboratory. The test is approved for use in the European Union and will soon be available in the US.

Prosigna™ detects the essential gene expression levels and categorizes breast tumors into one of four main subtypes by looking at the expression of 50 genes. Perou and Parker used the information to calculate a “risk of recurrence” score based on the subtype to predict the likelihood of a patient’s disease returning within the next 10 years. This score can help clinicians identify those low-risk patients for whom standard hormone therapy is sufficient to prevent relapse.

Dr. Perou, the May Goldman Shaw Professor of Molecular Oncology Research, received the 2013 Hyman L. Battle Distinguished Cancer Research Award in recognition of his accomplishments in cancer research. The award recognizes exceptional cancer research at the UNC School of Medicine.

Dr. Perou has been at the forefront of many groundbreaking studies on the subtypes of breast cancer – including one finding that genetically engineered mouse models can accurately predict human response to a standard chemotherapy drug combination commonly used in the clinic.

Research Priority 2: Drug Development and Delivery

UCRF is helping UNC scientists develop therapies and delivery methods that target vulnerabilities in cancer cells, while sparing normal tissues and having less toxic effects on patients. Comprehensive testing of a new drug takes more than 10 years, and the US Food and Drug Administration approves only about 5 percent of drugs that make it through this exhaustive process. With UCRF support, UNC is becoming a leader in finding a shorter path from discovery to the clinic – and to helping patients on a larger scale.

Mouse models improve drug development and promote collaboration

UCRF support led to the creation of the Mouse Phase I Unit, which has established multiple models of human cancer that can be bred in genetically identical mice. These mice can develop breast cancer, pancreatic cancer, lung cancer, ovarian cancer, melanoma, and other types of cancer with 100 percent incidence at defined times – providing researchers with a way to test innovative therapies quickly and accurately. These mouse models have enabled scientists to gain a better understanding of cancer’s response to 86 anti-cancer regimens, including 31 in the past year alone.

Eradicating cancer is a team effort, and UNC is part of many projects that involve partners across the country and the world. UCRF has enabled us to establish a comprehensive genetic mouse model resource available to scientists not only at UNC, but at other campuses as well. We are proud to work with researchers in North Carolina (e.g., North Carolina State University, Duke University, and NC Central University) and outside the state (e.g., Harvard, Emory, University of Michigan). This resource has proven valuable to commercial drug discovery as well, with several large and small pharmaceutical companies (e.g., Glaxo-Smith-Kline, Novartis, Merck) collaborating with the Mouse Phase I Unit.

Both industry and academic investigators have found the Mouse Phase I Unit highly valuable for developing novel therapeutics. For example, Ken Adler, a cell biologist at North Carolina State University is working on a way to stop cancer from metastasizing, or spreading through the body. Adler developed a small protein molecule, called a MANS peptide, that stops inflammation by inhibiting the movement of inflammatory cells. In a study published in *Oncogene*, Adler found that MANS was also able to stop lung-cancer cells from metastasizing in mice. He is using this information to advance a N.C. State biotech start-up.

Proteomic technology could predict patient resistance to cancer treatment

Proteomics is the study of how proteins in an organism affect cellular processes. This field of cancer research involves examining the role of a gene’s kinome – a set of 518 protein kinase genes that make the kinases that regulate the growth and metabolism of normal and cancer cells. About 400 of these kinase proteins are expressed in any individual cancer, but it has been difficult to ascertain which of these proteins, and how many, are actually active in a particular tumor. A team of UNC researchers led by Dr. Gary Johnson have developed a new pan-kinome analysis technology that

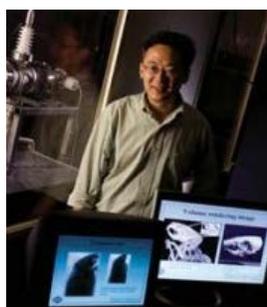
captures more than half of those kinases simultaneously, giving scientists a more comprehensive understanding of how various cancers evade treatment.

Just during the last year, new UCRF-purchased technology enabled the team to increase the test's sensitivity, raising the number of kinases captured in a single run from 170 to over 250. This can be done using smaller amounts of tumor tissue, allowing this new UCRF technology to study the kinome in small patient cancer biopsies. Drugs that inhibit the activity of kinase proteins are commonly used to treat cancer, but resistance often develops and tumors can recur over time. UNC's new proteomic technology is being used to

detect resistance within one week rather than waiting for a year. This could allow the oncologist to identify new combinations of drugs to overcome resistance to therapy and continue to effectively treat cancer.

After initially being applied to the development of drugs aimed at fighting the most aggressive types of breast cancer, the technology is now being used in human clinical trials for other types of breast cancer, as well as melanoma (a trial being performed collaboratively with GSK support). A new grant from the Lustgarten Foundation will allow this testing to be used in pancreatic cancer research, and funding from the Leukemia and Lymphoma Society will support kinome analysis in lymphoma research.

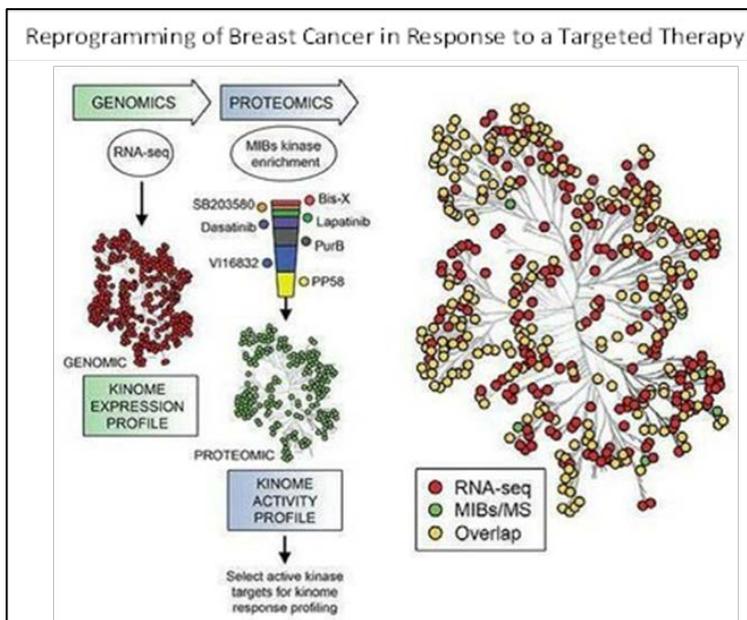
Clinical and prevention trials will be aided by new CT scanner technology developed by UNC researchers



The prototype of a new CT scanner has been developed at UNC that increases the scan's precision and speed while lowering radiation dose. Positive trials would introduce a new improved CT technology for the detection of small tumors and following tumors in clinical trials.

With UCRF support, UNC Lineberger member Dr. Otto Zhou, of the Carolina Center of Cancer Nanotechnology Excellence (C-CCNE), developed this new scanner using carbon nanotubes as the x-ray source. Zhou and his C-CCNE colleagues founded a company called Xintek, which is developing on the scanner in a joint venture with Siemens, a leading company in medical imaging.

The scanner contains 52 nanotube x-ray sources and detectors arranged in a ring, which eliminates the need to spin the x-ray source around the patient as with current CT scanners. This design also improves the precision and speed of scanning. The goal of this research is to develop a dynamic micro-computed tomography (micro-CT) system with enhanced spatial and temporal resolution and provide more versatile imaging capabilities compared to the current commercial micro-CT scanners. UNC is exploring its applications for biomedical research.



This joint venture will first provide a scanner that will maximize image resolution for in vivo scanning of mice. The proposed system will use a micro-focus field-emission x-ray source. Compared to the conventional micro-focus x-ray sources with thermionic cathodes, the new carbon nanotube (CNT) based field emission x-ray source offers high resolution at significantly reduced size. These capabilities will provide new imaging modalities for biomedical research such as dynamic cardiac and pulmonary imaging of small animals, which can then be used to improve researchers' capability to detect small tumors. The CT prototype is now being prepared for lung cancer human screening trials by UCRF recruit, Yue Lee, MD, PhD.

Research on obesity's link to ovarian cancer fosters collaboration, earns DOD support

Obesity leads to increased risk and worse outcomes for ovarian cancer but little is known of the timing or length of the obesity exposure that is the most critical for ovarian cancer development. UCRF-recruited faculty member Dr. Victoria Bae-Jump, MD, PhD, has created a unique mouse model she hopes will identify when women are the most vulnerable to obesity and ovarian cancer in their lifetime. This knowledge could enable doctors to identify ovarian cancer earlier and to develop individualized treatments catered to the patient, depending on her obesity status. The US Department of Defense awarded Dr. Bae-Jump a project grant for this research.



Victoria Bae-Jump



Liza Makowski

In another Department of Defense funded study, Dr. Bae Jump and her co-investigator, UCRF recruit Dr. Liza Makowski, PhD, will assess whether two novel chemotherapeutic agents – metformin and mTOR inhibitors – increase efficacy among obese patients with ovarian cancer. Dr. Makowski was also just awarded one of the very competitive Provocative Question grants from the National Cancer Institute to further define the link between cancer outcome and obesity.

UCRF funds have supported the recruitment of Dr. Steve Hursting, PhD, a national leader in obesity and cancer, to provide senior leadership for the program. Dr. Hursting, along with two recently recruited junior faculty, Dr. Makowski and UCRF recruit Michelle Mendez, PhD, a nutritional epidemiologist developing computerized methods for obtaining dietary history, will place UNC into a national leadership position in the effort to determine how obesity affects cancer – from initiation through treatment and survival.



Michelle Mendez

Research Priority 3: Improving Cancer Outcomes

Population-based, data-rich resources will help researchers better understand our state's cancer problems so that interventions can be developed to rectify these problems. UCRF has been instrumental in developing these tools to improve community prevention and early detection of cancer, and enhance the quality of oncology and survivor care across North Carolina.

Integrated database is strong research foundation

UCRF funding has helped build and support the Integrated Cancer Information and Surveillance System (ICISS), which encompasses all of the state's cancer cases (~49,000 yearly) and links more than 80 percent of North Carolina's cancer population to clinical, population and other data sources including Medicare, Medicaid, state employees, and Blue Cross Blue Shield of North Carolina health

claims data. This data-rich resource allows scientists to measure outcomes of cancer control activities – especially among vulnerable subgroups and communities that have been traditionally under-represented – and has been used in more than two dozen published papers. For example, one study used ICISS to find that the timing of initiation of radiation was still delayed for African-American women, although public health gains have been made regarding completion of radiation therapy in low-income women. Another ICISS- supported study analyzed cost effectiveness of therapies for prostate cancer, finding that an extremely expensive proton therapy was no more effective than more traditional and more affordable treatments. This resource allows a virtually unlimited range of public health topics to be examined – current studies include looking at physician workforce characteristics, demographics related to radiation utilization, treatment outcomes in urologic cancers, racial disparities in cancer care, North Carolina’s rating with regard to national quality measures, population and community patterns of colon cancer screening, the effect of groundwater arsenic on cancer incidence and outcomes, and many more.

Tobacco research funds focus on cancer prevention, biomarkers

UNC’s transdisciplinary tobacco program will expand dramatically, due to the recent award of two federal grants worth \$20 million apiece, making UNC home to two of the 14 established Tobacco Centers of Regulatory Science (TCORS) in the country. UCRF recruited and supported faculty were crucial to the conceptualization and competitiveness of these proposals. The communications research TCORS will be housed in UCRF space bringing together many of UNC Lineberger’s prevention faculty. The epithelial biology focused TCORS will be housed in the Imaging Research Building after it opens in January, 2014. Faculty in both the Lineberger building and IRB pulmonary medicine will be involved.

The first TCORS grant will be used to develop the UNC Center for Regulatory Research on Tobacco Communication (CRRTC), which will research the communication and prevention strategies around the FDA constituent analysis of tobacco smoke. The 46 faculty, staff and students at the multidisciplinary Center will work on three major studies into reinforcing communication with the public about the dangers of alternative tobacco products such as electronic cigarettes, hookahs and smokeless tobacco; the harmful effects of chemicals found naturally in tobacco and cigarette smoke; increasing the credibility of risk communications and health risks to audiences from diverse communities; and how to optimally communicate FDA authority over tobacco products. One of the projects is a collaboration with Wake Forest School of Medicine faculty.

The second TCORS grant will support the UNC Center for Tobacco Regulatory Science and Lung Health, which will focus on better understanding which components of tobacco and which new and emerging tobacco products have an adverse effect on lung hydration and innate immune defense. The 48 faculty, staff and students in this multi-disciplinary effort based in pulmonary medicine, with major projects led by UCRF recruited faculty including Claire Doerschuk, MD. The grant will support work on four separate projects to comprehensively understand how new and emerging tobacco products such as little cigars and hookah can be harmful to lung health, including the development of chronic bronchitis, impaired innate immunity, tobacco induced lung inflammation and mucus overproduction. The overall TCORS program will bring together investigators from across the country to aid in the development and evaluation of tobacco product regulations.

Giving child patients a voice in cancer care

Children with cancer experience significant toxicities, or adverse events (AEs), while undergoing treatment. Federal agencies require that AEs be documented in clinical trials. Clinician reporting is the current standard for reporting AEs, but Dr. Bryce Reeve is looking for ways to integrate the child's perspective into the reporting process.

Dr. Reeve, who was recruited to UNC from the National Cancer Institute with the support of UCRF, received a five-year \$2.5M grant for a study whose long-term goal is to create and validate a self-report measure of subjective AEs for children aged 7 years and older that will inform reporting for the National Cancer Institute's Common Terminology Criteria for Adverse Events (CTCAE). He and his colleagues recently completed a content validation study surveying nearly 200 pediatric clinicians in an effort to identify which of the 790 AEs in the current CTCAE should be included in a pediatric self-report measure. After the surveys, 64 CTCAE terms met the criteria of being subjective, relevant for use in pediatric cancer trials, and amenable to self-report by a child. The most frequent reasons for removal of CTCAE terms were that they relied on laboratory or clinical measures or were not applicable to children.

Dr. Reeve's next step is to translate these 64 AEs into child-friendly terms that will form the basis of the child-report toxicity measure. Ultimately, systematic collection of these data will improve care by enhancing the accuracy and completeness of treatment toxicity reports for childhood cancer.

New cancer-screening tools will help with early detection

Colorectal cancer is the second leading cause of cancer mortality in the country. Although screening rates for this cancer have increased in recent years, rates in Hispanic/Latino populations are among the lowest nationally. Latinos are more likely to be diagnosed with advanced stage colorectal cancer than non-Hispanic whites and have a lower probability of survival after diagnosis – and those with limited English proficiency (LEP) represent an especially vulnerable population due to communication challenges. To address this disparity, UNC Lineberger member Dr. Dan Reuland developed a Spanish language multimedia colorectal cancer screening decision aid that can be used in clinical practice.

Among the LEP Latinos in Reuland's study, knowledge of cancer screening increased by more than 50 percent after they viewed the decision aid. More than half the participants completing a follow-up survey reported discussing screening with a healthcare provider. Reuland is also testing a combined intervention involving a screening decision aid plus clinic-based bilingual patient navigator in a multi-site clinical trial at primary care clinics serving diverse, vulnerable patient populations both in North Carolina and in the Southwest US, using subjects in New Mexico.

UNC finds need for better coordination, communication with patients on survivorship care

Survivorship care plans (SCPs) are written plans used as tools to facilitate the transition from treatment to post-treatment cancer care. Though SCPs are commonly used, few studies have investigated survivor and provider preferences about the content, format, and delivery of SCPs. UCRF supported faculty member Dr. Deb Mayer, associate professor of nursing, led a pilot study to gain input from providers and survivors regarding the usefulness of SCPs in post-treatment care plans. Researchers found that while written SCPs were endorsed by all participating patients and primary care providers as helpful communication tools – but if used alone, the SCP is not sufficient to ease the transition to follow-up care. In her pilot study, Dr. Mayer found that improved communication and

care coordination were identified as important for survivorship care that went beyond what the SCP document provides.

Dr. Mayer is now expanding on her initial pilot, with the support of a Health-E-NC grant funded by UCRF, with two linked projects in four North Carolina counties. The first project will focus on the development and evaluation of paired sets of personalized survivorship care plans – one version for the patient, the other for the health care provider. Paired sets will be developed and tested for breast, colon, prostate, and lung cancer survivors who have completed cancer treatment. The second linked project will focus on enhancing coordinated care between oncology and primary care providers using the SCP and other identified communication strategies. Focus group participants – cancer survivors, primary care providers, and oncologists – will provide feedback on current versions of SCPs developed for patients and primary care providers, as well as on additional ways to improve communication and coordination of care during and after cancer treatment. Findings from the focus groups will guide a future survivorship care intervention that may influence care for cancer survivors across North Carolina and the country.

Training partnership with NC Central focuses on cancer disparities

African Americans have the highest cancer burden of any racial or ethnic group in the country. North Carolina Central University (NCCU) and UNC Lineberger have established an inter-institutional training program for undergraduate students who want to pursue careers in basic cancer research and in public health. UCRF supported faculty are involved and many of the student projects utilize UCRF-supported genomics and mouse infrastructures. The goal is to increase the number of undergraduate students from NCCU and UNC-Chapel Hill who pursue careers devoted to finding causes, cures, and prevention strategies for cancers that disproportionately affect minorities, particularly African Americans.

Community-based outreach aims to improve prevention



Health-e-NC (Health for Everyone in North Carolina) is a community-based partnership for statewide cancer strategies that aim to reduce risk factors, increase cancer screenings and referrals, help people make more informed decisions about their options for care, enhance treatment and survivorship, and improve prevention efforts across the state. UCRF-supported Health-e-NC funds a number of community-based pilot programs each year that fit with these goals.

One pilot project, Lose Now NC, hopes to reduce the risk of cancer by addressing the widespread problem of obesity. About 65 percent of NC adults were overweight or obese in 2011. Obesity has been linked to risk of several cancers, most notably breast and colon cancer, and also to decreased survival rates. Helping adults lose weight is a key strategy to reduce the cancer burden statewide, but the most effective weight-loss strategies involve intensive, individualized face-to-face counseling which is expensive and not widely accessible. Led by UCRF-supported faculty member Deb Tate, Lose Now NC studied whether a monthly face-to-face treatment in much larger groups (approximately 200 or more), coupled with an Internet program between sessions, could be an effective approach for achieving weight loss in NC communities. The study enrolled 195 people in



Deborah Tate

Mecklenburg and Cabarrus counties, and found that engagement in the program was high (75% retention at 4 months) and weight loss was significant (-3.69% of weight). Many of the Lose Now NC participants achieved clinically significant weight losses in this minimal intensity program. The Lose Now NC study showed that we could recruit a racially diverse group of study participants in a community-based program and successfully deliver a low intensity weight loss program that resulted in overall weight losses approaching clinical significance. The project used meeting space on the new Kanapolis campus.

Other pilot projects have involved promoting exercise among cancer survivors, using telemedicine to train staff of local survivorship centers, and introducing smoking cessation programs.

With UCRF support, Health-e-NC is also developing a web portal that will be a venue for evaluating state-of-the-art health promotion and cancer prevention programs and for sharing evidence-based tools and materials. Initially, the portal will offer an online resource tool called CHART (Carolina Health Assessment and Resource Tool) to be used as a core resource for Cancer Center researchers. CHART is a health behavior assessment tool offering core question modules and personalized, evidence-based and theory-guided message libraries (feedback) related to several behaviors that affect cancer outcomes. Additionally, formative research is currently being conducted to understand what online content and interactive tools adults, and particularly cancer survivors, want. Over time, mobile apps and resources will be incorporated to support optimizing cancer prevention, control, care and survivorship in our state.

SUCCESS STORY: UCRF helps recruit comparative effectiveness researcher with focus on treatment for older cancer patients

The Department of Epidemiology, with support from the UNC Lineberger and the UCRF, recruited a new assistant professor, Dr. Jennifer Lund. Dr. Lund obtained her Doctor of Philosophy in Epidemiology (2011) from The University of North Carolina at Chapel Hill. Since 2012 Dr. Lund has been a postdoctoral researcher in the Department of Clinical Epidemiology at Aarhus University in Denmark.

Dr. Lund's research focuses on pharmacoepidemiology and comparative effectiveness of medical interventions for cancer patients, especially for older persons with cancer. These data allow the evaluation of treatment efficacy and other health services research questions in a more "real world" population context than in clinical trials. Her dissertation research focused on the effectiveness of adjuvant oxaliplatin chemotherapy among older cancer patients with colorectal cancer. She is an important new epidemiology faculty member for the expanding cancer outcomes group, which includes investigators from the UNC Schools of Public Health and Medicine.

Tier 2: Opportunity Fund

As the field of cancer research evolves, the Opportunity Fund allows us to remain agile and to seize research and clinical opportunities as they arise, and enables us to provide the top minds in the field with the resources they need. UCRF funds competitive and innovative pilot projects, provides seed money to recruit top researchers, supports leading-edge technology and equipment that multiple faculty members can use, and facilitates the development of shared research resources.

UNC researchers aim to understand how Hepatitis C leads to liver cancer



Lishan Su

Two UNC scientists have received \$2.35 million from the National Cancer Institute to better determine how the Hepatitis C virus affects the development of liver cancer.

Lishan Su, PhD, professor of microbiology and immunology, and Stanley Lemon, MD, professor of medicine and microbiology and immunology, lead teams that use technologies developed in each of their laboratories to collaborate on the project. Dr. Lemon was a UCRF recruit and Dr. Su's work was funded by an Innovation Award.

Chronic Hepatitis C infection is the leading cause of liver cancer in the United States, Hepatitis B the leading cause worldwide. Lemon and Su will study whether inflammation associated with hepatitis C causes liver cancer, or whether the virus facilitates the development of cancer by affecting host cells in other ways.

Lemon and Su's work centers on a novel mouse model developed by Su; the mouse is altered so it has both a human immune system and human liver cells. Human cells are only cells that can be infected with hepatitis virus; so this work could not proceed in a normal mouse. Su's innovation has created a mouse model that can be infected with human hepatitis C virus, and when infected with the Hepatitis C virus, the mouse develops a human immune response to the virus. The inflammation leads to liver disease, fibrosis and cancer. Affecting about 3.2 million Americans, Hepatitis C is the most common chronic blood-borne infection in the country according to the Centers for Disease Control. Liver cancer is the third leading cause of death worldwide and the ninth leading cause of cancer deaths in the United States; chronic viral hepatitis account for more than two thirds of these cases. The Su / Lemon team will be able to study therapy to eliminate the virus and explore what leads from infection to cancer.



Stanley Lemon

In addition to this collaborative project with Lemon, Su recently was awarded a \$2 million, four-year grant from the National Institute of Health to investigate using a novel immune therapy to treat chronic hepatitis B virus (HBV) infection, which affects more than 350 million patients worldwide. Su and colleagues intend to use their innovative humanized mouse model to build a better understanding of the way in which HBV infections and the patient's immune response leads to fibrosis/cirrhosis and, eventually, liver cancer.

Building capacity in cancer research

Although the Strategic Plan concentrates about 50 percent of UCRF resources on three Tier 1 Research Priorities, the field of cancer research is continually evolving. As a result, new opportunities for strategically important research have been developing – and will continue to do so – outside the Tier 1 priorities. Recruiting and retaining outstanding faculty is critical to our efforts to fight cancer, and the Opportunity Fund has successfully helped UNC recruit and retain researchers in order to build capacity in key areas of study. For example, more people die of lung cancer than any other kind of cancer. This year, thanks to UCRF, we were able to recruit three outstanding faculty members from Johns Hopkins, University of Michigan, and MD Anderson specializing in lung cancer. This will enhance our research capabilities involving this most lethal cancer subtype.

One example is UCRF recruit Dr. Chad Pecot, MD, a lung cancer specialist with an interest in how RNA interference regulates cancer metastases. Trained at Vanderbilt and MD Anderson, Dr. Pecot

understands that metastases are responsible for the majority of cancer deaths. Therefore, he is devising methods to target the metastatic process using nanoparticle-based drug delivery. He was attracted to UNC over four other offers by our UCRF-developed nanomedicine program. He also will explore the cellular regulatory networks involved with metastatic lung cancer with the goal of developing microRNA-based therapies to inhibit metastases in these cancers.

SUCCESS STORY: Rimer receives ACS Medal of Honor, leads presidential cancer panel



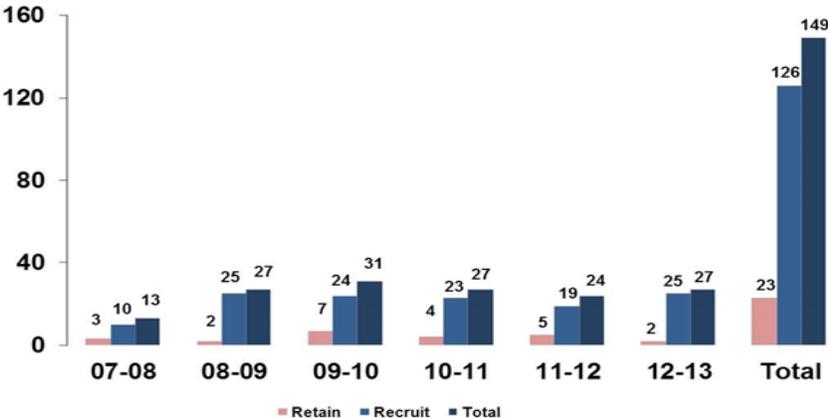
Barbara K. Rimer, DrPH, Dean and Alumni Distinguished Professor of the University of North Carolina Gillings School of Global Public Health, has been awarded the American Cancer Society (ACS) Medal of Honor – the Society’s highest honor – for her work in cancer research. The ACS chose Dr. Rimer for "her work in breast cancer screening, which has guided national research, practice and policy for more than 20 years. Her work has evolved with the field from raising awareness of screening and increasing screening initiation, to promoting screening maintenance."

President Obama has named Rimer chair of the President’s Cancer Panel, which was established as part of the National Cancer Act signed by President Nixon in 1971. The three-member panel monitors the development and execution of the activities of the National Cancer Program, and reports directly to the President on barriers to program implementation. Dr. Rimer, who has been on the UNC faculty since 2003, is a UNC Lineberger member and served as its deputy director until she was appointed dean in 2005. She serves on the Cancer Research Committee that oversees the investment of UCRF funds. Dean Rimer has been a vital partner in the development of UCRF public health projects and recruitments.

Recruitment and Retention by Year

The following graph shows the number of UCRF supported faculty recruitments and retentions in each year of UCRF funding. The total is nearing 150 active faculty, improving UNC’s ability to eliminate the cancer burden in North Carolina and the world by creating new knowledge through research.

UCRF Recruitment By Year



Promoting innovation and leveraging external funds

The Innovation Awards, highly competitive internal seed grants supported by UCRF, aim to promote innovation at UNC and cultivate the next generation of cancer research. These awards have stimulated research across the public health, clinical and basic science spectrum and provide data with which to seek new external funding.

- From 2007 to 2013, UCRF conducted nine rounds of competition and received 495 applications.
- Rigorous peer reviews led to 81 awards, a funding rate of about one in six, for a total of \$13.45 million.
- Follow-up results from the round 1 (2007) found that the \$2.4 million in awards resulted in more than 20 extramural grant awards with projected total funding (all years) of \$20.4 million.
- Initial follow-up results from rounds 2, 3, and 4 found that investigators credited funding of 42 external grant awards to their Innovation Award support. Those grants accounted for \$10.7 million in external funding for FY 2013 alone. The total amount of funding across all years of support will be followed.
- In addition, awards in rounds 2, 3, and 4 directly or indirectly contributed to four patent filings, and two startup companies.

Tier 3: Infrastructure

Imaging Research Building will greatly expand cancer research space

This winter, the Imaging Research Building (IRB), located next to the Lineberger building, will open its doors, greatly enhancing our capacity for cancer research. More than half the building will be occupied by UNC Lineberger members, with one floor, 24,000 square feet of lab space, assigned to expand Lineberger building space. The IRB will house three floors of imaging technology and equipment, one floor for the NCI-funded CCNE, two floors of chemical hood intensive space for drug development efforts, and two additional floors of general laboratory space for the Department of Microbiology and Immunology and the Pulmonary Biology group, including the new TCORS epithelial biology grant.

The new facility, funded by the General Assembly in 2009, will bring the physical and chemical sciences much closer to the Lineberger headquarters building. The imaging component of the IRB will add tremendous value to our translational research efforts, bringing all small animal imaging modalities together and providing new clinical research capabilities and technology, including MRI/PET and CT/PET scanners, a 7TMRI, a cyclotron, and radiochemistry facilities. There will be space for studies following patients during cancer therapy, allowing new avenues for assessing patient response and resistance.

SUCCESS STORY: Nuclear medicine expert to be leader in cancer patient imaging research

The UCRF played a key role in the successful recruitment of Dr. Terry Wong, MD, PhD, a radiologist who has been appointed UNC's chief of nuclear medicine and leader of our translational, functional imaging research program.

When the Imaging Research Building opens, Dr. Wong's role as Associate Director for Clinical Translation of the Biomedical Resource Imaging Center will expand. He will lead collaborations with other disciplines to maximize the cutting-edge technologies that will be available for cancer clinical trials.

His research interests include PET/CT, PET/MR, advanced MR and CT, novel PET tracers, with his primary interest being the development and application of functional and anatomic imaging biomarkers to guide and evaluate cancer treatment decisions. Dr. Wong has participated in several significant studies on a variety of topics including exploring radium-based treatments for prostate patients with metastatic bone disease, and evaluating how changes in tissue due to radiation can affect the study of heart and lung conditions. He is a member of the national cancer cooperative group, ACRIN, which conducts imaging and cancer clinical trials.

Telemedicine sites expand reach of tumor expertise

The University Cancer Research Fund investment in telemedicine has extended the reach of UNC experts to 42 sites in more than twenty communities across the state. Affiliated physicians videoconference with a team of UNC experts from a wide variety of specialties who meet and discuss treatment plans for patients during weekly Multidisciplinary Oncology Tumor Boards. Doctors at Wilson Medical Center, Rex Hospitals, Moses Cone, Marion L. Shepard Cancer Center, Carteret Memorial Hospital and Mission Hospitals participate in Tumor Board conferences as patient cases warrant. This year we were also able to expand our program to Angel Medical Center in Franklin County and Chatham Hospital in Siler City by leveraging federal dollars for the USDA to install state-of-the-art telepresence systems. Cancer research conferences between East Carolina University and UNC occur on a bi-monthly basis. The videoconferencing system is also used to facilitate the distribution of Lunch and Learn lectures from Dare County to other communities. In selected specialties lacking in rural communities, physician-to-patient consultations also are provided via telemedicine. The Comprehensive Cancer Support Program provides mental health support for cancer patients. In addition, the Clinical Genetics Program offers genetics counseling to patients via Telemedicine.

Clinical excellence and outreach are vital in quality cancer care

It is a sad fact that roughly one third of patients diagnosed with cancer will die from the disease. It is our objective to change those outcomes through new knowledge and discovery. To do that, we must have a faculty that create new research knowledge in their areas of specific cancer expertise and – through our outreach programs – make those advances available to patients across the state.

UCRF has played a critical role in our efforts to assemble an outstanding group of clinical research-oriented oncologists who enable N.C. Cancer Hospital to provide the highest level of expertise. Our faculty is intimately engaged in clinical and translational research, with a commitment to helping cancer patients in North Carolina and beyond.

SUCCESS STORY: Single dads' group offers support for cancer widowers

Fathers whose spouses die from cancer are not only grieving, but taking care of their children alone – and often with few places to turn for help. In 2010, UCRF recruits Don Rosenstein, MD, and Justin Yopp, PhD, launched an educational series and support program – the first of its kind in the nation – to reach out to these widowers and give them somewhere to turn.

“Newly widowed fathers represent a potentially vulnerable population as they cope with their own grief, their children’s grief, and the day-to-day demands of being a single parent,” program coordinator Justin Yopp, PhD, said. “This population of fathers has been largely overlooked in the literature and we know of no previous interventions specifically tailored to their needs.”

Yopp, who was recruited to UNC from St. Jude’s Hospital with UCRF support, is an assistant professor of psychiatry. His co-author is Don Rosenstein, MD, professor of psychiatry and director of the UNC Comprehensive Cancer Support Program who was recruited from the National Institutes of Health.

Single Fathers Due to Cancer grew out of Rosenstein and Yopp’s work with young mothers who were dying of cancer and their families. During counseling sessions, mothers expressed concerns about how their husbands and children were coping with their terminal illness and would cope after their death.

“The fathers in our support group have told us that they benefitted from the opportunity to meet with and learn from other fathers in their situation,” Yopp said. “Our goal now is to develop a research agenda to systematically explore the most effective ways to intervene with these fathers, and our hope is that this publication will spur similar interest from investigators and clinicians.”

BUDGET AND EXPENDITURE INFORMATION

UCRF Funding Sources and Revenue

The 2007 law establishing the UCRF stated that North Carolina should provide a minimum of \$50 million annually for cancer research under UNC Hospitals, the UNC Lineberger Cancer Center, or both. The Fund initially received \$25 million in 2007 and \$40 million in 2008 before reaching its full funding amount of \$50 million in 2009. The UCRF has been supported by three funding sources: tobacco settlement funds, taxes on other (non-cigarette) tobacco products such as snuff, and state appropriations. In 2013 the General Assembly eliminated tobacco settlement funds as a source of support for FY 2013-2014, reducing the UCRF to \$42 million.

Since 2009, total funding has fallen slightly short of the \$50 million objective stated in law due to lower than expected receipts from the tax on other tobacco products. For the fourth year in a row, these receipts less than projected. The FY 2012-2013 shortfall of \$355,479 was, however, very significantly improved over the prior years’ shortfalls, which ranged had ranged from ~\$1.0 million to \$2.1 million.

FY 12-13 Anticipated and Actual Fund Revenue	Amount *
Anticipated	
State Appropriation	\$16,020,000
Tobacco Trust Fund Transfer	\$8,000,000
Projected OTP Tax Receipts	\$25,980,000
Total	\$50,000,000
Actual	
State Appropriation	\$16,020,000
Tobacco Trust Fund Transfer	\$8,000,000
Actual OTP Tax Receipts	\$25,624,521
Total	\$49,644,521
Shortfall Due to OTP Tax Receipts	\$355,479

* Rounded to the nearest dollar

Fund Balance

This year the UCRF had a carryover of \$39,881. Expenses closely matched revenues, and the year-end fund balance was \$83,720.

FY 12-13 Budget and Expenditures	Amount \$
Anticipated Budget	
Revenue	\$50,000,000
Carryover from FY12	\$39,881
Total	\$50,039,881
Actual Budget	
Revenue	\$49,644,521
Carryover from FY12	\$39,881
Total	\$49,684,402
Expenditures	\$49,600,682
Balance	\$83,720

* Rounded to the nearest dollar

Restrictions on the Use of UCRF Monies

The General Assembly created the University Cancer Research Fund as part of the 2007 budget. G.S. 116-29.1, by which the Fund was created, established the Fund as a special revenue fund in the Office of the President of the University of North Carolina. This law, included as an appendix to this report, established the Cancer Research Fund Committee as an oversight measure and explicitly states that 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.”

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 ground rules to guide how UCRF funds would be best spent. They 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; 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 cancer investment and to ensure wise and responsible use of the funding, the Strategic Plan also imposed additional restrictions on the use of these funds. It was determined 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.

Expenditures of State Funds related to UCRF

As mandated by G.S. 116-29.1(g), the table below provides an accounting of expenditures of state funding related to the University Cancer Research Fund. Further details regarding these expenditures are included as appendices to this report. Only 1.5 percent of the total UCRF budget is used for ongoing administrative expenses.

Categories	FY 12-13 Expenses
Strategic Plan Categories	
Tier 1: Research Priorities	
Understanding Genetics	\$7,792,331
Developing Novel Therapies	\$8,217,708
Optimizing Outcomes	\$6,316,088
Tier 2: Opportunity Fund	\$9,057,328
Tier 3: Critical Infrastructure	
Clinical Excellence – Research & Outreach	\$9,614,344
Research & Tech Development and Training	\$8,602,884
Total	\$49,600,682

CONCLUSION

The University Cancer Research Fund is sparking innovative research that is changing cancer prevention, early detection and care in North Carolina and the world. UCRF is promoting collaborations with other universities and with the private sector, and is connecting communities all across our state with better resources for care. Additionally, UCRF is leveraging unprecedented amounts of outside funding. The result has been to move UNC into the top ten nationally in biomedical research funding – making the national research community take notice and creating jobs and commercialization opportunities that will benefit our economy, producing greater than a 5-to-1 return on investment.

The economic and health impacts of this investment have been significant, and will continue to be so in the years to come. We are grateful for the legislature’s ongoing support of UCRF and we continue to utilize these funds responsibly and strategically. The University Cancer Research Fund has been a truly remarkable investment in cancer care that will have a lasting impact in and beyond our state. As we work every day to improve prevention, treatment and outcomes, our ultimate goal continues to be making North Carolina’s deadliest disease a thing of the past.