

THE POWER OF ADVANCED MEDICINE: LESS CANCER. **MORE LIVING.**



UNIVERSITY OF KENTUCKY MARKEY CANCER CENTER
ANNUAL REPORT 2016



UNIVERSITY OF KENTUCKY
MARKEY CANCER
FOUNDATION



HealthCare
MARKEY CANCER CENTER

An NCI-Designated Cancer Center

RECOGNITION AND ACHIEVEMENTS



A Cancer Center Designated by the
National Cancer Institute



UK HealthCare is the No. 1 hospital in Kentucky in the 2016-17 *U.S. News & World Report's* Best Hospitals rankings, and the hospital's cancer services are the highest ranked in the state.



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Front cover, left: Kathleen O'Connor, PhD, and her team at the UK Markey Cancer Center are developing a clinical trial that could change the way triple-negative breast cancers are treated.

Front cover, right: After conquering a challenging liver cancer diagnosis, Teresa Schladt is living a full life with few limitations.

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MARKEY IS HARNESSING THE POWER OF ADVANCED MEDICINE

In a state like Kentucky and a region like Central Appalachia – where cancer is at its worst – it takes bold action to make a difference.

At the University of Kentucky Markey Cancer Center, being bold is at the heart of everything we do. We're harnessing the power of advanced medicine to explore the latest in cancer research and treatment, recruit the brightest minds from across the country, and extend our expertise across the state and region – all to lessen the toll cancer takes on patients and their families.

Our goal of significantly reducing cancer incidence and mortality in Appalachia by 2020 is ambitious. But the momentum we're building gives us the confidence that we can make it happen.

Since 2013, when the Markey Cancer Center was designated by the National Cancer Institute, our wave of progress has not slowed. We're now treating more than 100,000 patients each year, including almost 3,500 new cancer cases in 2015 alone.

Being centrally located in Lexington, we're proud of the impact we're making in the lives of people across the entire state and our region. Additions to the Markey Cancer Center Affiliate and Research networks have expanded our reach from the eastern parts of Appalachia to Western Kentucky.

With the philanthropic support of the Markey Cancer Foundation, we're bringing together some of the best minds in cancer research and treatment to fight the disease through new, exciting initiatives. This year, we are creating a statewide molecular tumor board, a first for the state of Kentucky. This will give cancer specialists across the region access to the most up-to-date technologies and therapies, while also giving patients more treatment options based on the unique genetic characteristics of their particular cancer.

At Markey, the power of advanced medicine means more than research innovations and treatment breakthroughs. It means giving patients and their families the assurance that a cancer diagnosis does not define the lives they lead.

It means less cancer, more living.

B. Mark Evers, MD
Director, UK Markey Cancer Center



An NCI-Designated Cancer Center

CREATING THE FOUNDATION FOR SUCCESS

At the University of Kentucky Markey Cancer Foundation, our job is to champion the work being done at the Markey Cancer Center. By telling Markey's story, we create connections and foster friendships that allow our experts to make a difference in the lives of those affected by cancer.

Kentucky's unfortunate distinction of having the highest cancer incidence and mortality rates in the country doesn't just make our job critically important – it makes it profoundly personal.

Many of our board members have been affected by cancer, and all of us understand the significant burden the disease places on patients and families across the state and region. That is why we're so energized to help Dr. Mark Evers make his bold vision for Markey a reality.

Dr. Evers' ambitious goals, including achieving comprehensive cancer center designation from the National Cancer Institute, have helped guide our efforts to recruit world-class talent to Lexington and fund exciting, life-saving research. From enhancing precision medicine initiatives to promoting prevention and screening, we're here to support Markey's goals every step of the way.

In this past year the foundation has welcomed a new CEO, commenced a strategic planning process and laid the groundwork to increase our support to equal that of an NCI comprehensive cancer center. It's this type of support that will help Markey conquer cancer in Kentucky and beyond.

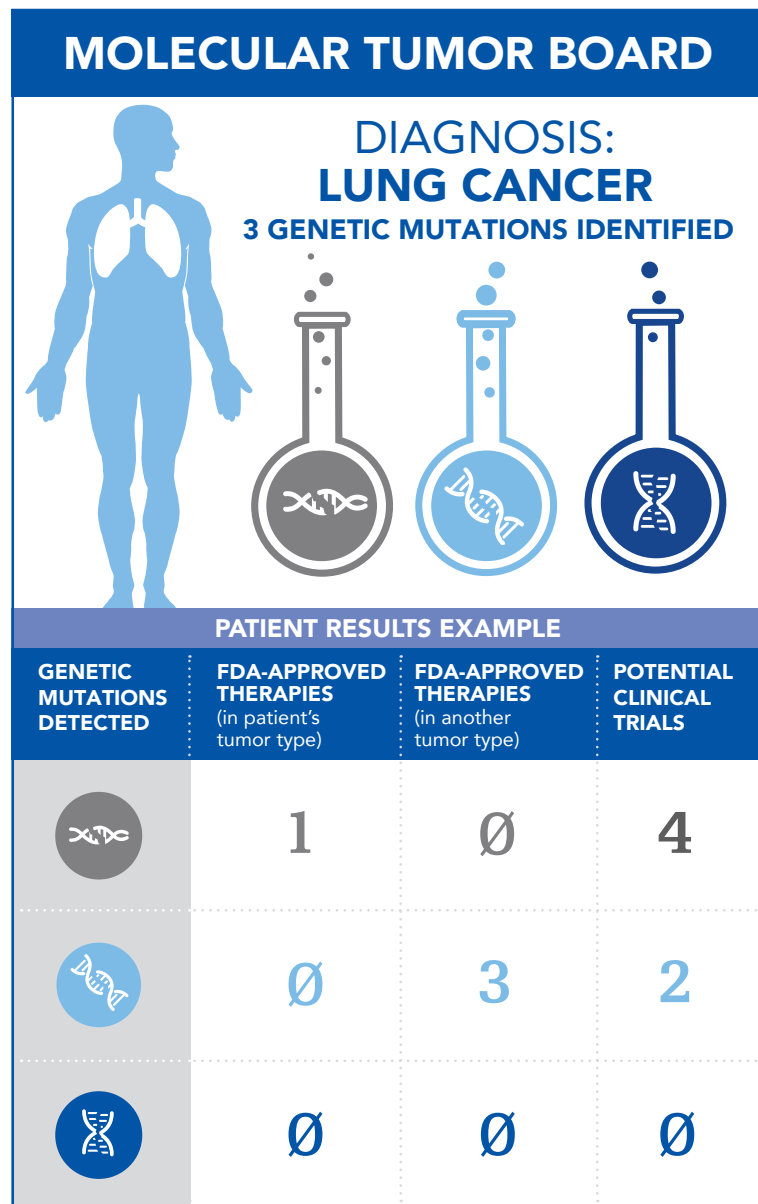
Our job isn't just about raising money, however. It's about building long-lasting relationships that will help sustain Markey's efforts into the future.

When we bring people together for a cause that's greater than themselves, it's exciting to see the life-changing impact we can make.

We invite you to join us.



Sally Humphrey
Chair, UK Markey Cancer Foundation



The UK Markey Cancer Center stands on the cusp of a new chapter in its precision medicine efforts with the launch of two initiatives: the Markey Cancer Center Molecular Tumor Board and the Early Phase Clinical Trials Center.

Each of these initiatives will advance Markey's commitment to precision medicine, an approach to cancer care that uses genetic analysis to help oncologists choose cancer therapies attuned to each patient's individual needs.

"Oncology is now more genetic-based, whereas before it was based upon tumor types," said Markey Director B. Mark Evers, MD, FACS. "By understanding the genetic makeup of our patients and their tumors, we can then help to direct their therapy."

The Molecular Tumor Board launched in October 2016. It is co-directed by Markey's Rachel W. Miller, MD, and Jill Kolesar, MS, PharmD, who recently joined Markey and the UK College of Pharmacy from the University of Wisconsin-Madison, where she started a similar initiative.

The Molecular Tumor Board will analyze the molecular characteristics of cancer tumors on a case-by-case basis and provide individualized recommendations for treatment. In doing so, it will also create a cache of information to direct the development of new therapies that target the types of cancers found at Markey and throughout Kentucky.

Evers hopes this wealth of information will make the Molecular Tumor Board a resource for cancer physicians across the Commonwealth in the future. Doctors would be able to send the molecular specifics of a patient's tumor to the experts at Markey and receive advice on the latest treatment options that might work for that specific patient.

In addition to recommending therapies targeted to the specific genetic mutations that providers treat, the Molecular Tumor Board will also help drive the development of new

therapies and clinical trials that specifically target these mutations, Miller said.

"The Molecular Tumor Board provides not only an opportunity for our patients, but also an opportunity for physicians to gain a better understanding of the function of the specific mutations and how to best target these molecular characteristics," she said.

"Launching the center will help us bring more clinical trials to patients with cancer in Kentucky."

– Jill Kolesar, MS, PharmD

To develop these new and novel therapies, Markey is launching the Early Phase Clinical Trials Center, which will focus on providing patients with increased access to phase I and phase II clinical trials. These early-phase studies can offer patients new treatment avenues for cancers that have proved difficult to target through standard therapies.

"Launching the center will help us bring more clinical trials to patients with cancer in Kentucky," said Kolesar, who will serve as director of the center, drawing upon her experience in the clinical pharmacology of anti-cancer compounds and the implementation of clinical trials.

The center will encourage the development of phase I and II clinical trials at Markey – known as investigator-initiated trials – as well as seek out such trials at other institutions when appropriate.

Moreover, the center will have dedicated space and resources at Markey, ensuring that patients

participating in early-phase trials will have the support they need. Patients will have access to navigators who will provide one-on-one support as well as to dedicated infusion nurses who will administer therapies and monitor patients. Working with this staff will be a multidisciplinary team of physicians, pharmacists and nurses.

"The center will provide patients with an enhanced experience," Kolesar said. "We will ensure every patient receives individualized care and support, and they have the advantage of an interprofessional team working together to coordinate and provide their care."

Evers said the two new endeavors represent a new phase in Markey's commitment to precision medicine – one that will directly benefit patients across the Commonwealth.

"We're using this as an opportunity to really reach out and personalize treatment for patients with cancer throughout Kentucky," he said.

Gynecological oncologist Rachel W. Miller, MD (left), Sivakumaran Theru Arumugam, PhD, FACMG, director, clinical molecular and genomic pathology (middle), and Jill Kolesar, MS, PharmD, director of the Early Phase Clinical Trials Center (right), have spearheaded the launch of the Molecular Tumor Board at the UK Markey Cancer Center. The tumor board advances Markey's commitment to precision medicine.



CLINGING TO LIFE, MARKEY PATIENT SAVED BY CLINICAL TRIAL

In 2003, Kentucky native Geri McDowell pursued medical help out of state after experiencing a prolonged gastrointestinal illness that her local doctors couldn't explain. Her ultimate diagnosis: neuroendocrine cancer in her GI tract.

Neuroendocrine tumors are relatively rare, afflicting about 8,000 Americans a year. The neuroendocrine system comprises cells from both the nervous system and endocrine system, and this system regulates the physiological processes of the human body. Neuroendocrine tumors begin in the hormone-producing cells of this system, and they are frequently found in the lungs or GI tract.

McDowell underwent surgery to remove the mass. Afterward, she came home and life returned to normal – until five years later, when she noticed her unusual GI symptoms returning and sought medical advice again.

The cancer had recurred, this time with metastasis to her liver. She was sent back to Kentucky with instructions to find an oncologist who could help her manage her disease.

"They just told me, well, there's no treatment and no cure," she said. "The tumors I have in the liver, they're inoperable."

McDowell chose the UK Markey Cancer Center for her care. At the time, Markey did not have

an oncologist who specialized in neuroendocrine cancers. But when Lowell Anthony, MD, arrived in 2012, McDowell transferred into his care. With regular Sandostatin® injections, her tumors remained fairly stable and she maintained a normal life.

"At one point during her ordeal, she was on her deathbed. We were doing everything we could to keep her with us, to get her on that trial."

– Lowell Anthony, MD

However, neuroendocrine tumors wreak havoc on a patient's hormones, leading to serious damage in other areas of the body. In McDowell's case, her tumors produced too much serotonin. Excess serotonin in the body can cause a build-up of scar tissue in major organs, a fibrosis that Anthony describes as almost "wood-like."

McDowell's tricuspid heart valve began to fail, and she underwent open-heart surgery followed by the installation of a pacemaker and stent. But she struggled to recover. Then the mitral valve in her heart also began to fail, requiring her to be on oxygen 24/7.

In the meantime, Anthony doggedly searched for a clinical trial that suited McDowell, knowing that it was likely her best chance for survival. She finally

qualified for one of his trials in early 2015, just as her health was reaching an all-time low.

"At one point during her ordeal, she was on her deathbed," Anthony said. "Her husband called in her pastor, friends and family. We were doing everything we could to keep her with us, to get her on that trial."

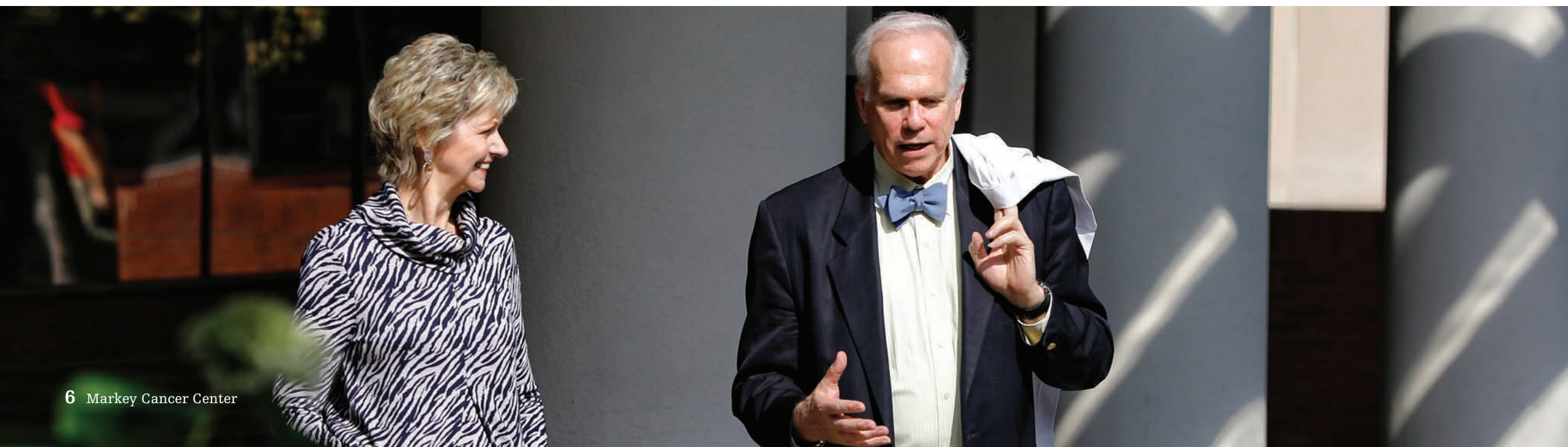
McDowell hung on, and began taking the trial medication. She slowly grew stronger over the following months, building up her stamina and gaining weight. Her shortness of breath dissipated, and she weaned herself off of the supplemental oxygen. More than a year after beginning the clinical trial, McDowell is feeling the strongest and healthiest she has in many years.

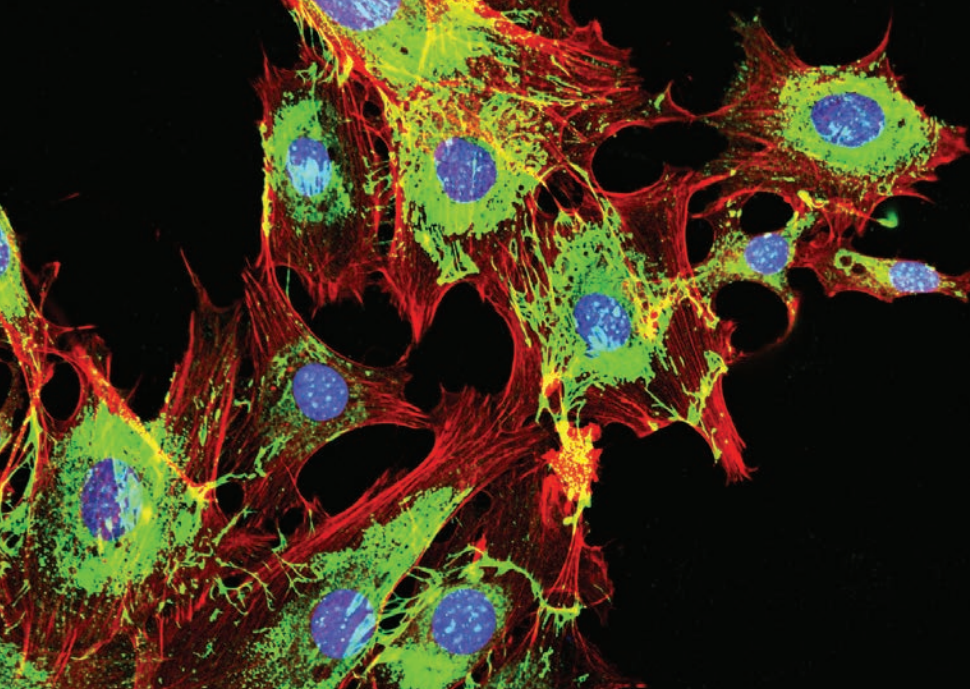
Anthony affectionately calls her his "zebra," noting that much like every zebra has its own distinctive striping, McDowell's extraordinary reaction to her treatment is also unique and special.

While the term "clinical trial" can sound scary to someone who has never participated, McDowell is happy to dispel any myths surrounding trial participation and educate others on her experience.

"It's always scary to think about somebody asking you if you want to be on a clinical trial," she said. "But I trusted Dr. Anthony with anything, and when he thought it was the best thing, I said, 'Absolutely!' And even if it didn't help me, it might help someone else."

With the help of clinical trial recommended by neuroendocrine cancer specialist Lowell Anthony, MD, (bottom right) Geri McDowell (bottom left, right) is back to doing the things she loves, like playing golf.





SITTING DOWN WITH ROBERT DIPAOLO, CANCER RESEARCHER AND DEAN OF THE UK COLLEGE OF MEDICINE

In 2016, Robert DiPaola, MD, was hired as the dean of the UK College of Medicine. DiPaola arrived at UK after serving as the director of the Rutgers Cancer Institute of New Jersey and brought with him an extensive cancer research portfolio as well as years of experience kick-starting impactful translational science.

Although his responsibilities as dean cover a wide array of programs and endeavors beyond the realm of cancer, DiPaola's prior experience as the director of a National Cancer Institute-designated Comprehensive Cancer Center has helped create a powerful partnership between the College of Medicine and the UK Markey Cancer Center.

DiPaola sat down to discuss the cancer research he brings to UK and how his role as dean of the College of Medicine can help Markey achieve its lofty goals.

Describe your prior experience as a cancer researcher.

I started out in the translational research arena with a focus on genitourinary malignancies and prostate cancer. I helped to launch several smaller local trials and then, over time, I ended up designing more trials nationally. I was then elected to chair the GU Committee of the Eastern Cooperative Oncology Group, and that's where our team got to launch some phase III clinical trials that had an impact on changing the standard of care.

I've really been involved with every phase of research, from the lab that did the preclinical modeling to designing early trials – phase I, II and then phase III – where we were looking to change the standard of care. I had the opportunity to go back and forth from the lab to the clinic. I'd see the clinical problems and then work to figure out how we could tackle those back into the lab. I encourage the development of multidisciplinary teams knowing that a team approach could have greater impact to help discovery be translated to patients.

What are you most proud of as a cancer researcher?

Fostering the development of multidisciplinary research teams to best improve the standard of care for patients. When I was in the lab, I worked to create preclinical models that could help us develop new clinical trials with a focus on drug resistance. We're trying to answer the question: What's the next treatment for a patient who is resistant to current standard therapies?

Will you continue to do cancer research at UK given your leadership role?

Yes, I will continue to work on our research on autophagy – the process in which cells are destroyed. We published a paper earlier this year, on a preclinical model for prostate cancer. Now we're planning to do preclinical studies to look at this

process as a drug resistance mechanism and design clinical trials going forward. I will also be involved in some early clinical trials research as a multiple principal investigator of a UM1 grant with Ohio State University.

In your role as dean, how can you help tackle the cancer challenges we see in Kentucky?

I would say addressing the overarching health issues in Markey's catchment area, which includes the minority and underserved populations across Kentucky. High rates of cancer mortality, obesity and tobacco use are some of our greatest challenges. What can we do to help this population? That's what we as an academic health system have to answer.

"We're the hub of health care in Kentucky, and we have the potential to really enhance our transdisciplinary, translational research efforts."

– Robert DiPaola, MD

One thing that I can do is help make all those efforts that are relevant to cancer more cohesive so Markey can leverage more opportunities – whether it's opportunities in expertise, additional researchers or infrastructure.

How are you working with Markey leadership to enhance the cancer research happening across UK's campus?

One thing we've worked together on is co-recruitment. We're in the process of hiring a new chair in the College of Medicine, but this person will also have a major role at Markey in developing and leading new research endeavors. It's a way to align things optimally for Markey across the organization.

We have the potential to make an impact, and I want the College of Medicine to be helpful in any way possible. Mark Evers and I have a great partnership and we talk almost every day. I met Mark before coming to UK and always thought he was an incredible director, leading Markey toward a bright future and bringing people together.

What most excites you about working with Markey?

I think it's the strength we have here in research and the responsibility we have to the people of Kentucky. We're the hub of health care in Kentucky, and we have the potential to really enhance our transdisciplinary and translational research efforts.

Those efforts must cut across everything we do at UK – all areas of science, all areas that could positively impact patients and the people of the Commonwealth.

RAISING THE BAR ACROSS KENTUCKY AND BEYOND

The UK Markey Cancer Center's mission to be the region's hub for cancer expertise is perhaps no better exemplified than in its Affiliate and Research networks.

These initiatives offer community hospitals and cancer centers the opportunity to work collaboratively with Markey to improve cancer care across Kentucky and beyond its borders.

"It's not just about saying the word 'cancer'. It's about speaking the language of cancer in Kentucky."

– Timothy Mullett, MD

Founded in 2006, the UK Markey Cancer Center Affiliate Network aims to improve access to high-quality cancer care for patients throughout Kentucky and Appalachia. It now includes 16 partner sites in Kentucky, with a footprint reaching to Henderson in the west, Bowling Green in the southwest, Somerset in the southeast and Ashland in the east.

For Timothy Mullett, MD, medical director of the Affiliate and Research networks, these collaborative relationships illustrate Markey's ability to provide meaningful leadership and support for leading-edge cancer care – a key component to Markey's role as Kentucky's only cancer center designated by the National Cancer Institute.

"The Affiliate Network is about improving quality across the region to keep patients close to home for high-quality cancer care," Mullett said.

To do this, Markey assesses the cancer care program at each potential Affiliate Network site and determines an individualized plan to support that hospital or center so it can best serve its patients.

The resources Markey offers may include education, training on surgical techniques, or information on new medical oncology or radiation therapies. Programs may be long-established or just getting off the ground. In each case, the approach is the same, Mullett said: Meet them where they are, assess where they need support and provide it.

While Mullett's team works to reinforce the quality of community-based cancer programs, it also focuses on improving access to new and novel cancer therapies for patients throughout Kentucky.

To improve access to these leading-edge clinical trials, Markey created the Research Network, a group of sites – now five and counting – that demonstrates the capability to implement and oversee clinical trials.

These collaborations allow Markey to provide access to new and novel therapies to an ever-increasing number of cancer patients in Kentucky and Appalachia within the comfort of their own

communities. The footprint of the Research Network reaches west to Elizabethtown and east all the way to West Virginia.

While Markey continues to expand its Affiliate Network and its Research Network, Mullett stressed the importance of thinking not only in terms of reach, but also in terms of targeting the specific needs of Kentuckians.

"I think Kentucky and our region have a different focus on cancer than what the national perspective of cancer is," he said, noting the area's high incidence of lung cancer and colon cancer, which can be exacerbated by additional genetic and health-related issues.

To address these specific needs, Markey's Affiliate Network is advocating for early detection measures like lung cancer screening, while Research Network members work with Markey researchers on clinical trials aimed directly at the cancers Kentuckians face. It's an approach to tackling cancer that casts a wide net, but does so with precision, and Mullett is hopeful it will have an impact.

"It's not just about saying the word 'cancer'," he said. "It's about speaking the language of cancer in Kentucky."

To learn more about the Markey Cancer Center Affiliate Network and Research Network, visit markey.uky.edu.

AFFILIATE NETWORK CELEBRATES 10TH ANNIVERSARY

The mission of the Markey Cancer Center Affiliate Network from the day it was founded in 2006 has been to provide high-quality cancer care close to home for patients across Kentucky.

What began as a three-site network has grown to 16 sites and counting. Through its work over the past decade, Markey and its Affiliate Network partners have helped more and more Kentuckians access the best-available cancer care.

Cheri Tolle, MAEd, CHES, administrative director of the Affiliate Network, said the growth during the last 10 years has been gratifying but she remains focused on the network's unchanged core mission.

"It's more than putting dots on the map," she said. "It's about really helping communities to raise the quality of cancer care across the state."



BIG DATA HELPS CANCER PATIENTS FIND BEST TREATMENTS

When people think of the “fight against cancer,” they might imagine doctors counseling patients or white-coated researchers looking through a microscope.

Those conversations in the clinic and experiments in the lab, however, wouldn’t be possible without the critical information provided by cancer registries.

In the Commonwealth, the Kentucky Cancer Registry (KCR) has been dedicated to providing medical personnel with valuable cancer data for 30 years. The KCR is a real-time database that collects information about cancer diagnoses from across Kentucky, giving researchers and clinicians comprehensive data and patients faster access to relevant clinical trials.

KCR was selected in 2000 to join the National Cancer Institute’s Surveillance, Epidemiology and End Results (SEER) program, a group considered to be among the most accurate and complete population-based cancer registries in the world.

Housed at the UK Markey Cancer Center, the registry is overseen by director Thomas Tucker, PhD, MPH, who also serves as associate director for cancer prevention and control at Markey. Tucker has worked with the surveillance program since its inception, an era when cancer cases were mailed via paper forms and manually edited.

Today, using a sophisticated informatics method called Natural Language Processing, the KCR

receives pathology reports in real time from all of the pathology labs that see histologic material from Kentucky cancer patients.

Patients don’t have time to waste in pursuing their best option for treatment. That’s where the real-time pathology reports become especially important, says Eric Durbin, DrPH, MS, director of cancer informatics for the KCR.

“The registry is the eyes of our public health effort to control the cancer burden in the Commonwealth.”

– Thomas Tucker, PhD, MPH

“For example, in late-stage lung cancer patients, median survival time is between eight and nine months,” Durbin said. “If you’re going to recruit those patients into a study, you have to get to them quickly. Using the electronic pathology reporting for patients seen at the University of Kentucky, we know about their cancer diagnosis almost at the same time as their physician. It gives us an opportunity to reach out to those patients and determine if they’re interested in enrolling in a clinical trial.”

In addition to providing data on cancer patients, the KCR also serves as a “virtual, population-based tissue repository.” By keeping track of electronic pathology reports for every cancer patient, the KCR is able to locate the tissue taken from patients at the

time of their surgery or biopsy. These tissues can be invaluable for specific research projects.

Although tissue repositories exist across the country, the KCR is unique in that its data is truly population-based.

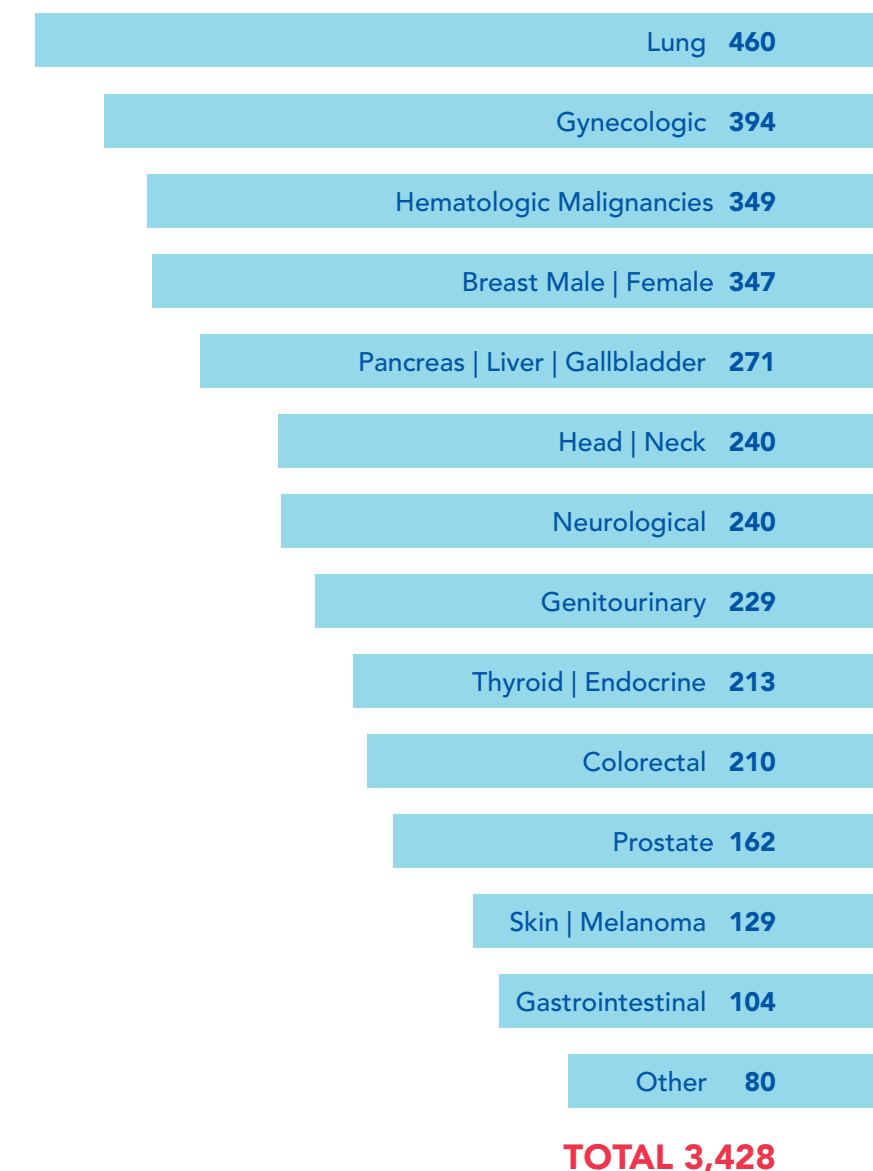
“It allows us to generalize the findings from individual studies to the underlying population, and that dramatically elevates the science,” Tucker said.

The registry has grown tremendously since its launch. In 1986, only about 60 percent of Kentucky hospitals were voluntarily reporting their cancer cases. In 1990, the Kentucky General Assembly passed a law making the KCR the official population-based cancer surveillance program for the state and mandating reporting to the system.

The registry has played an important role in aiding researchers and clinicians throughout Kentucky, and Tucker says it will continue to be a major part of Markey’s efforts to reduce the burden of cancer in the state.

“If you can’t see where incidence is occurring, you can’t allocate resources to address the problem, and you won’t be able to see if your efforts to reduce the cancer burden are being effective,” Tucker said. “The registry is the eyes of our public health effort to control the cancer burden in the Commonwealth.”

UK MARKEY CANCER CENTER CANCER CASES BY TUMOR SITE, CALENDAR YEAR 2015



IT TAKES A TEAM TO TACKLE TOUGH LIVER CANCER

Teresa Schladt's self-portrait, painted in 2013 during an art therapy project for patients at UK HealthCare, shows the Lexington, Ky. woman springing into a star-filled, midnight-blue sky. Inside each star is the name of someone who supported her through her 2007 liver transplant and cancer treatment and in the days since.

As the now-55-year-old looks at the painting and considers the life she has, she is quick to remind others and herself: "I am one of the luckiest people you have ever met. I am happy with life."

Diagnosed with a genetic disorder at 35

Schladt was diagnosed at age 35 with alpha-1-antitrypsin (AAT) deficiency, a genetic disorder that can damage the liver and lungs. For a decade after her diagnosis, she lived an active, near-normal life. But in late 2006, her liver began to fail.

Under the guidance of surgeon Roberto Gedaly, MD, director of the UK Transplant Center, Schladt began the required tests and screenings for a transplant in January 2007. She was placed on the transplant list in March and received a new liver in June.

A cancer diagnosis on the heels of a liver transplant

Schladt's transplant went well, but 10 days later, tests on the removed liver revealed 10 small cancerous lesions.

Because Schladt's cancer was advanced, with multiple lesions, Gedaly referred her to Philip DeSimone, MD, a medical oncologist at the UK Markey Cancer Center.

"You need to be aggressive when you have spent so much time and so much effort in saving someone's life."

– Philip DeSimone, MD

Both Gedaly, whose research area is liver cancer, and DeSimone, whose practice areas include liver, pancreatic, gastrointestinal and colorectal cancers, knew that a drug used primarily for kidney cancer, Nexavar®, was being used off-label in some liver cancer cases after liver transplantation. There was little data to show it was effective in cases like

Schladt's, but both doctors felt it was worth a try.

DeSimone pulled no punches. Schladt had two choices: Nexavar or no additional treatment.

"She was nice and appreciative of what I was trying to do," DeSimone said, "even though there was little, really no data, to show if [the treatment] was either good or bad. But you need to be aggressive when you have spent so much time and so much effort in saving someone's life."

Schladt opted to take Nexavar in pill form. The six-month chemotherapy regimen left her sick and weak, but she has no regrets and has remained cancer-free.

Since Schladt's surgery, the connection between the two specialty areas – transplantation and cancer – has become even more structured at UK HealthCare with the creation of a Liver Tumor Board. Board members from transplant, oncology, radiation oncology, radiology and gastroenterology discuss every patient with liver tumors.

Enjoying a fulfilling life

Even as Schladt contends with continuing health problems caused by AAT deficiency, she is living a full life with few limits.

She's active in the community, and for the past two years she's been a member of the Markey Cancer Center Patient Advisory Group.

The art therapy project at UK reawakened a long-dormant interest in art, and she now spends time painting in her downtown condo. During the day, the sun beams in. At night, she sees stars, a shining reminder, she said, of the stellar support system that has seen her through the last nine years.

Roberto Gedaly, MD (left), surgeon at the UK Transplant Center, worked with UK Markey Cancer Center oncologist Philip DeSimone, MD (far right), to treat Teresa Schladt's (center) complex liver cancer.





Jon Thorson, PhD, professor of pharmaceutical sciences at the UK College of Pharmacy, leads a team of researchers searching for exotic microorganisms living underground that could potentially lead to breakthrough cancer treatments.

THE POWER OF MINING FOR A CURE

Jon Thorson, PhD, thinks the next great treatment for cancer might be found in a very unlikely place – a coal mine.

Thorson is a professor of pharmaceutical sciences at the UK College of Pharmacy and heads the UK Center for Pharmaceutical Research and Innovation. He leads a team of researchers scouring subterranean areas of Eastern Kentucky, including abandoned coal mines, in hopes of finding particularly resilient microbes.

These exotic microorganisms – ones that survive in the harsh conditions below earth’s surface – produce natural chemical “superpowers” that allow them to thrive in areas otherwise inhospitable for life. It’s these superpowers that Thorson says could hold the key to developing new and effective treatments for diseases like cancer.

When Thorson’s team finds a microorganism in an environment like a coal mine, they take it back to the lab to harness its unique chemical compounds. These compounds are also known as natural products.

“Natural products, they’re basically molecules that have evolved for function over time,”

said Thorson, who is also the co-director of the Drug Discovery, Delivery and Translational Therapeutics Program at the UK Markey Cancer Center. “You can make very minor changes to molecules that we already know, and that can lead to dramatic changes in the way that the molecules behave in the body.”

“You start with a leg up by working with unusual organisms and things that people have not investigated before.”

– Jon Thorson, PhD

Natural product development has yielded major pharmaceutical breakthroughs before. A wide array of dependable drugs that treat conditions such as certain types of cancer, bacterial and fungal infections, and inflammation have all been found through the discovery of exotic microorganisms in unique places across the globe.

Thorson thinks the untapped subterranean environments of Kentucky – specifically coal fires burning beneath the ground, underground coal mines and soil samples extracted from deep within earth through natural gas drilling – might be the next place for a breakthrough. Because coal

fires burn at such high temperatures, for example, the microorganisms that are able to survive there are unique. And that uniqueness allows researchers to hit the ground running when looking for potentially life-saving natural products.

“You start with a leg up by working with unusual organisms and things that people have not investigated before,” he said.

Since Thorson’s lab began its coal mine sampling in 2012, it has isolated a handful of compounds with pharmacological potential that have advanced into further study.

One of these was discovered early on – a set of compounds that could restore the ability of cells to repress cancer growth. Qing-Bai She, PhD, of the UK Pharmacology & Nutritional Sciences Department and Markos Leggas, PhD, in the UK College of Pharmacy and Center for Pharmaceutical Research and Innovation are currently studying the compounds *in vivo*, and the project recently achieved external funding to continue to advance.

The team also recently discovered that the mechanism of these natural products has relevance to treating malaria. The plan is to further explore this avenue of research through a collaboration

with Kip Guy, PhD, the dean of the UK College of Pharmacy.

Additionally, the team is collaborating with UK researchers on compounds that may offer protection against alcohol-induced toxicities.

Looking to the future, Thorson is hopeful to add to that list of promising compounds isolated from the Appalachian depths by streamlining the compound identification process to allow for the greatest chemical diversity.

As his team perfects the process, they’ll be charting a completely new territory in natural products development, because although there has been research into mines in other areas of the country and the world, his team is the first to utilize sites in Kentucky for this work.

For Thorson, that is precisely the point: “We’re one of the first natural products focus groups to be looking at those certain populations,” he said. “There’s something unique about Kentucky in terms of its environment – and that’s really the driver here.”



EDUCATING KENTUCKY'S YOUTH ON CANCER

Standing in front of a group of rowdy children, Eastern Kentucky native Melissa Hounshell only has to do one thing to grab the kids' attention – bring out Mr. Gross Mouth.

Aptly named, Mr. Gross Mouth is a prop set of teeth and gums beleaguered by various medical problems caused by smoking and/or poor hygiene – rotting teeth, tongue cancer, lesions and more. The kids excitedly voice their shock and disgust as Hounshell educates them on the bad habits that might lead to such a set of teeth in real life.

As the UK Markey Cancer Center's community outreach director, Hounshell spends her days traveling across Kentucky, partnering with businesses and programs in local communities to raise awareness and educate the public about cancer risk factors and screenings.

One of her latest endeavors is a youth outreach program called Get Fit, Be Smart, Don't Start. Using eye-catching props like Mr. Gross Mouth, the program encourages young children to take an interest in their parents' health in addition to their own.

Many adults in the region avoid cancer screenings out of fear of what they might find, which is why Hounshell said it's so important to get children involved.

"We feel like it's really important to work with children in the state," Hounshell said. "What we're really trying to do is reach that younger population and change that mindset, to make them understand the importance and value of health and wellness throughout their lives."

"I encourage kids many times to go and talk with their parents or grandparents about either stopping smoking or getting mammograms or colonoscopies."

– Melissa Hounshell

Overall, the youth program emphasizes a healthy lifestyle encompassing a good diet, staying active, avoiding smoking and tobacco products, and even understanding the dangers of distracted driving. But considering Kentucky's No. 1 ranking in both cancer incidence and mortality in the country, the likelihood of these children having some connection to cancer in their family is high, and Hounshell hopes her message of prevention resonates with the young audience.

"I encourage kids many times to go and talk with their parents or grandparents about either stopping smoking or getting mammograms or colonoscopies, because so many times a child can ask someone to do something and they'll do it," she said.

As Markey ramps up its efforts to bring the message about cancer prevention to the younger generation of Kentuckians, it also offers students the opportunity to visit the cancer center to learn more about what it takes to fight the deadly disease. Since 2012, Markey has hosted Meet the Researchers Day, an educational event offered as a prize for two schools in the region who raise money for the Leukemia and Lymphoma Society's Pennies for Patients program.

During Meet the Researchers Day, students rotate between presentations from Markey clinicians and researchers and are also given tours of clinic space and a research lab. During the lab tours, they get the opportunity to perform experiments with basic lab equipment.

UK pediatric hematologist/oncologist John D'Orazio, MD, PhD, has participated in the event since its inception, giving youngsters a quick overview of what exactly cancer is and how it's treated.

"The best part is when I get asked questions that show some of these kids are serious about pursuing a medical career," D'Orazio said. "All of us look back and have a moment that inspired us to become who we are. Meet the Researchers Day has the potential to inspire curious kids."

DR. JOHN D'ORAZIO, UK PEDIATRIC HEMATOLOGY/ONCOLOGY

In addition to treating pediatric cancer patients, John D'Orazio, MD, PhD, specializes in research on melanoma, the deadliest form of skin cancer. His work focuses on the hormonal pathways that protect the skin from sun damage and how efficiently the skin's DNA may be able to repair itself.

In a previous study, D'Orazio's team discovered that a genetic defect in the melanocortin1 receptor (MC1R) leads to a reduced ability to repair DNA, making people with the defect more susceptible to developing melanoma.

D'Orazio's team is currently working on a new project to further those findings, focusing on the specific hormones that appear to "turn off" MC1R signaling, also leading to an increased likelihood of developing the cancer. His latest work is supported by the Melanoma Research Alliance (MRA), the largest private funder of melanoma research; the UK Markey Cancer Foundation; and DanceBlue, the University of Kentucky's student-run fundraiser for pediatric cancer.



Top left: Melissa Hounshell, Markey's community outreach director, has started a youth outreach program for kids across Kentucky. The program encourages young children to take an interest in their own health as well as the health of their parents and family.

Center left: Students work with Tianyan Gao, PhD, during Markey's Meet the Researchers Day, an annual event where kids get hands-on learning experience with Markey researchers and clinicians.

CONQUERING A LATE-STAGE LUNG CANCER DIAGNOSIS

It started with a cough that just wouldn't quit. Vickie Duff tried taking allergy medicines, but the cough that started in the summer lingered into fall.

As a breast cancer survivor, Duff, 58, had regularly scheduled follow-up appointments with her oncologist. At one of these appointments she had a coughing fit, and her oncologist listened to her lungs. He then immediately recommended a chest X-ray.

"I knew in the back of my mind that it was probably something more than a cough," Duff said. "When we met with the doctor to discuss the X-ray results, the first thing he said was 'I'm so glad you brought your husband with you today.' That's when I knew it was bad."

The X-ray confirmed Duff's worst fears – she had stage III lung cancer.

Dealing with her diagnosis

Lung cancer is the most common form of cancer worldwide, and Kentucky leads the nation in lung cancer incidence and mortality. Smoking and exposure to secondhand smoke are among the top risk factors for the disease.

Although she had since quit, Duff had smoked earlier in life.

Her advanced stage IIIA diagnosis meant her tumor was large when it was discovered. Treatment for lung cancer usually includes surgery to remove the cancer followed by chemotherapy and/or radiation.

"I knew there were survivors out there who had lived long past that. I want to be one of them."

– Vickie Duff

Survival rates for lung cancer are much lower than other common types of cancer. Less than 18 percent of people with lung cancer survive five years, and more than half of all people with the disease die within one year of diagnosis. When detected early, survival may be as high as 70 percent, but for patients with advanced disease like Duff's, the outlook is more dire – only 4 to 20 percent of patients survive five years.

Facing those tough odds, Duff was determined to find a cancer surgeon in

the Lexington area with whom she felt comfortable. Duff's sister, who works at UK HealthCare, recommended Timothy Mullett, MD, a cardiothoracic surgeon at the UK Markey Cancer Center who specializes in lung cancer treatment.

Compassionate care at UK

Mullett was straightforward, telling Duff her cancer was advanced and that treatment would be difficult. Still, he remained supportive as he recommended a care plan that included surgery to remove the cancer and chemotherapy afterward to kill any remaining cancer cells.

"Dr. Mullett was encouraging and positive," Duff said. "We knew my condition was serious, but he was confident."

In order to remove the cancer, Mullett had to take out Duff's entire left lung.

Despite the intense procedure, Duff said she felt better as soon as she woke up. "I knew it was out of me," she said. "I felt great."

Treatment and recovery

Duff recovered in the hospital for four days. Her surgery happened in September, and her treatment plan called for six months of chemotherapy under the direction of Markey oncologist Susanne Arnold, MD, and her team.

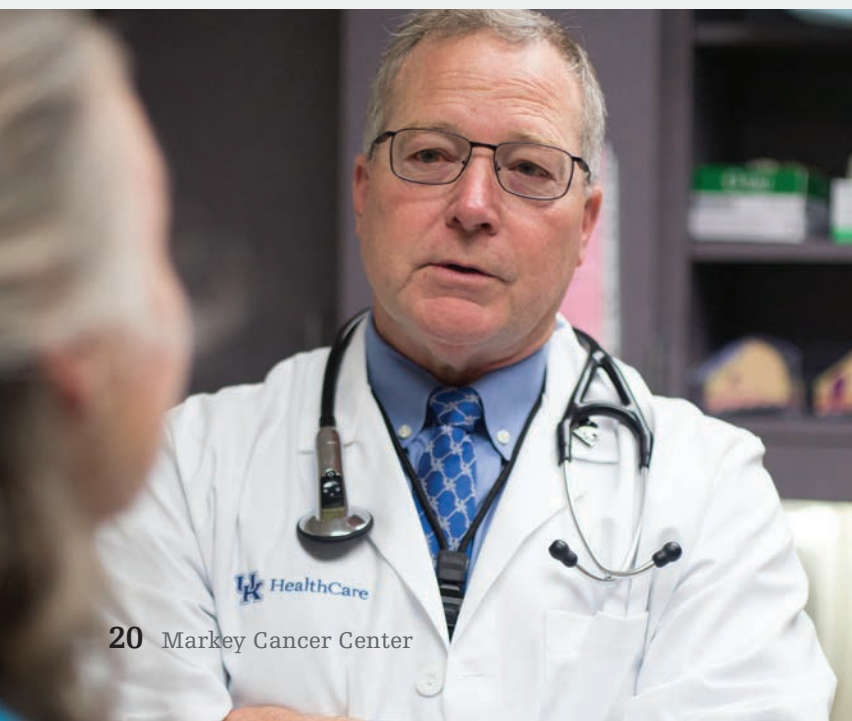
Duff's final chemotherapy session in February happened to fall on her birthday, so she turned the day into a party. Family, friends and members of her care team came together to celebrate.

"It was a wonderful feeling," Duff said. "I couldn't have felt more cared for."

September 2016 marked six years since Duff's surgery. She's been cancer-free since her chemotherapy ended in 2011, giving her the time and health to enjoy the company of her five grandchildren and her husband of 35 years.

"The doctors, they told me the life expectancy for my cancer – it was five years or so," Duff recalled. "But I knew there were survivors out there who had lived long past that. I want to be one of them."

Timothy Mullett, MD (left), a thoracic surgeon at the UK Markey Cancer Center treated Vickie Duff (right) for late-stage lung cancer. After surgery and six months of chemotherapy, Duff has been cancer free for six years.





RESTORING QUALITY OF LIFE, ONE BITE AT A TIME

Food can be one of life's great joys, but for cancer patients, eating can become a chore.

Cancer therapies can cause loss of smell, affecting how flavors are perceived on a person's palate. The result can be devastating: patients losing the desire to eat at a time when they need balanced nutrition the most.

It's a problem Dan Han, PsyD, clinical section chief of neuropsychology at UK HealthCare, also encounters. Han works with patients who have brain injuries and neurodegenerative disorders, many of whom describe loss of smell and, in tandem, changes in the way food tastes. Like most clinicians, Han had observed these issues in his own patients for years but viewed these side effects as unavoidable.

"I ask every one of my patients now, 'How's your smell and taste? How is that aspect of your quality of life?'"

– Dan Han, PsyD

That changed in 2012, after a chance encounter with internationally renowned chef Fred Morin. Han and Morin discovered they shared a passion for neurogastronomy, the science of the brain and behavior in relation to food. Their conversation inspired Han to reconsider how this science could help patients with brain injuries or cancer. Could foods be designed that adjusted for the flavor perception issues reported by these patients?

Two years later, Han, Morin and others co-founded the International Society of Neurogastronomy (ISN) with the intent to start answering this very question. In late 2015, the ISN held its first symposium at UK HealthCare. Chefs, doctors, clinical psychologists, agriculturists, researchers and cancer patients gathered for the event, which included roundtable discussions and engaging presentations. During the symposium, Morin engineered a taste test for a UK Markey Cancer

Center patient in which Morin and other chefs presented dishes with manipulated flavors intended to make them more palatable. The Markey patient – and others involved – provided favorable, insightful feedback on the results.

In fact, the response to the entire event was so enthusiastic that Han and others in the ISN began to think about how to expand the organization's scope. In response, the 2016 symposium will also consider how food can be manipulated to enhance the taste perception of healthy foods, and potentially make unhealthy and carcinogenic foods less appealing. As a result, the ISN could seek not only to improve the flavors of food for patients with impaired smell and taste but also help prevent cancer and illness in the first place.

Beyond advancing the field of neurogastronomy and its wealth of potential, Han hopes that the ISN's work can help clinicians better understand the importance of taste perception for a patient's well-being. Indeed, he finds his own approach has been changed by his research.

"I ask every one of my patients now, 'How's your smell and taste? How is that aspect of your quality of life?'" Han said. "It wasn't until I started asking that I noticed how many people will tell you that it has been compromised. But nobody's asked about it and they never thought to bring it up because they never heard of mentioning that type of thing in the doctor's office."

"We're trying to challenge that," he adds, "so that patients undergoing treatment can recover their quality of life – a little bit at least."

At right, from the 2015 International Society of Neurogastronomy Symposium: tasting stations gave attendees a hands-on sensory experience of the relationship between science and taste. Dishes were sampled by patients with taste impairment caused by chemotherapy.



TRIPLE-NEGATIVE BREAST CANCER CLINICAL TRIAL GAINS MOMENTUM

Triple-negative breast cancer is a moniker given to a particularly aggressive group of breast cancers that often affect younger women.

Unlike other types of breast cancer, which have biomarkers that tell oncologists which treatment the patient should respond to, triple-negative breast cancers have no definitive biomarkers.

“If we can do this, then the oncologists will no longer have to guess.”

– Kathleen O'Connor, PhD

That means if the patient does not respond well to the current standard of care, it's up to her oncologist to make an educated guess about which chemotherapy will do the job.

The good news is that triple-negative breast cancers do generally respond well to chemotherapy. However, because triple-negative breast cancers are not all the same, and every single patient responds differently to various chemotherapies, it's difficult to predict which chemotherapy will best treat each patient's cancer.

But researchers at the UK Markey Cancer Center are working to change that paradox. Markey's Breast Translational Group is currently developing

a proposed clinical trial that could create a major shift in the way triple-negative breast cancers are treated.

Currently, after a patient is diagnosed with triple-negative breast cancer, she often receives chemotherapy first to try to shrink the tumor (known as neoadjuvant therapy), followed by surgery to remove any remaining cancer. She is then monitored for signs of recurrence. If a patient has tumor remaining in the breast despite getting neoadjuvant chemotherapy, her cancer is at a somewhat higher risk for spreading.

There are currently at least six different types of chemotherapy that can be used as a possible therapy for patients, and each one may affect each individual patient in a different way. To tailor the treatment to each distinct patient, the Markey investigators aim to test the tumors in a set of animal model “avatars” with these different therapies to gauge the response.

Here's how the proposed trial would work: After the patient's biopsy, her cancerous tissue would be transferred into a mouse that is bred to grow human tumors, then subsequently into three dozen mice: her “avatars.” While the patient undergoes neoadjuvant chemotherapy and then surgery – a process that can take up to six months – the

avatars will be divided into groups, with each group receiving one of the six available chemotherapies.

When the researchers see which avatar group has the best result, they'll know which chemotherapy should work best for that patient. Knowing this would provide additional options for women who have residual cancer after neoadjuvant chemotherapy and may reduce their risk for disease recurrence.

“It would prevent us from having to experiment with each individual patient, and end up finding that they didn't respond to that therapy,” said Kathleen O'Connor, PhD, director of Markey's Breast Translational Group. “If we can do this, then the oncologists will no longer have to guess.”

Aju Mathew, MD, MPhil, a medical oncologist who treats triple-negative breast cancer patients at Markey, compares his team's game-changing proposition to the way Uber has disrupted the use of public and personal transportation.

“This trial is our way of disrupting the current standard of care, the current technology and the current practice of medicine, to try to change

UK Markey Cancer Center researchers Aju Mathew, MD, MPhil (left), Kathleen O'Connor, PhD (middle), and Edward Romond, MD (right), are developing a clinical trial that could create a major change in the way triple-negative breast cancers are treated.

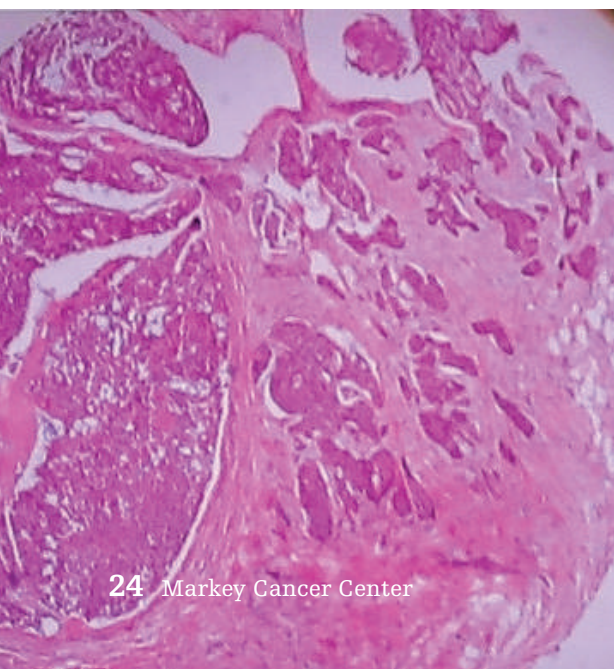
the paradigm of a ‘one size fits all’ approach for triple-negative breast cancer patients,” Mathew said.

Although the avatar model of research isn't new, O'Connor notes that not many researchers are using them specifically for the treatment of an individual patient. Using a trial protocol to get the tissues directly from the patient's biopsy is a key factor in making the research work.

With the trial design in place, the team just needs to provide ample data showing that growing a patient's tumor in the avatar from biopsy will work.

Initial pilot funds stemming from Markey's National Cancer Institute (NCI) designation grant have enabled the team to establish its first set of avatars with tissues taken from patients' surgeries. But a boost in support would help them establish the preliminary data for the trial and allow the team to then apply for major federal funding.

On the next page, find out how one mother is carrying on her daughter's legacy to raise awareness and support for triple-negative breast cancer research, including the work being done by the experts at Markey.



MOTHER CONTINUES DAUGHTER'S FIGHT TO RAISE BREAST CANCER AWARENESS

Funding for triple-negative breast cancer has been a major focus for Lexington resident Cindy Praska, whose daughter Whitney was diagnosed with the disease in 2007 at age 24. After undergoing a double mastectomy, chemotherapy and radiation at another hospital, Whitney was deemed cancer-free.

“It’s an honor to be supporting Markey, who we called family and home the last year of her life.”

– *Cindy Praska, Whitney’s mother*

In the years following her diagnosis, Whitney became an advocate for breast cancer awareness and fundraising, becoming actively involved in the Frankfort Country Club’s Rally for the Cure, which has raised money for the Susan G. Komen Foundation and the UK Markey Cancer Center for nearly 20 years.

Although her initial treatment for triple-negative breast cancer was successful, Whitney then

developed osteosarcoma (bone cancer) in 2012. Despite Whitney’s and her doctors’ best efforts, her cancer metastasized and she succumbed to the disease in November of that year.

Carrying the torch for her daughter, Cindy continues to push for education, awareness and research toward triple-negative breast cancer and is still heavily involved in fundraising. Her efforts included a special fundraising gala in October 2016 that featured a silent and live auction, with all proceeds directly benefiting the Markey research team’s proposed triple-negative breast cancer clinical trial.

“Whitney helped bring awareness to this disease, and it is so rewarding to me that work is progressing so that more young women her age will live to marry, have a family, and be able to see their young children grow up,” Cindy said. “It has given me a purpose to be an advocate for these causes and it’s an honor to be supporting Markey, who we called family and home the last year of her life.”

‘FOREVER AN ADVOCATE FOR THE UNDERDOG’

Cancer is not selective about who or when it strikes. It can afflict anyone, changing a vibrant, community-minded and exceedingly charitable individual in the prime of her life into a statistic, as it did with Cathy Wolterman Coop.

Cathy was a wife, mother, sister, friend and medical professional who was diagnosed with cancer. While receiving treatment at the UK Markey Cancer Center, she often told family and friends of the women she sat with during her chemotherapy, many of whom were driving themselves to and from treatments while working full-time jobs to support their families and themselves.

“The most meaningful way we could honor her memory was creating this fund that would benefit those going through the same treatment.”

– *Brent Coop, Cathy’s husband*

“Cathy lived close to Markey, we had financial stability and she had a strong support system, but those people who did not weighed on her heavily. She was forever an advocate for the underdog,” said Cathy’s widower, Brent.

In her honor, Brent, along with the Wolterman family and Cathy’s friends, started the Cathy Wolterman Coop Fund, which raises funds for those receiving treatment for primary peritoneal or ovarian cancer. Presented to her as a legacy on her final birthday, the fund offers financial assistance for items such as transportation to treatments, groceries, hotel rooms for family members, meals, childcare, medication co-pays and other basic needs.

“The most meaningful way we could honor her memory was creating this fund that would benefit those going through the same treatment as her, but in many cases were in much more difficult financial situations,” Brent said.

For more information on the Cathy Wolterman Coop Fund, or any of the philanthropic efforts carried out by the UK Markey Cancer Foundation, visit www.ukmarkey.org.

UK MARKEY CANCER FOUNDATION BOARD OF TRUSTEES

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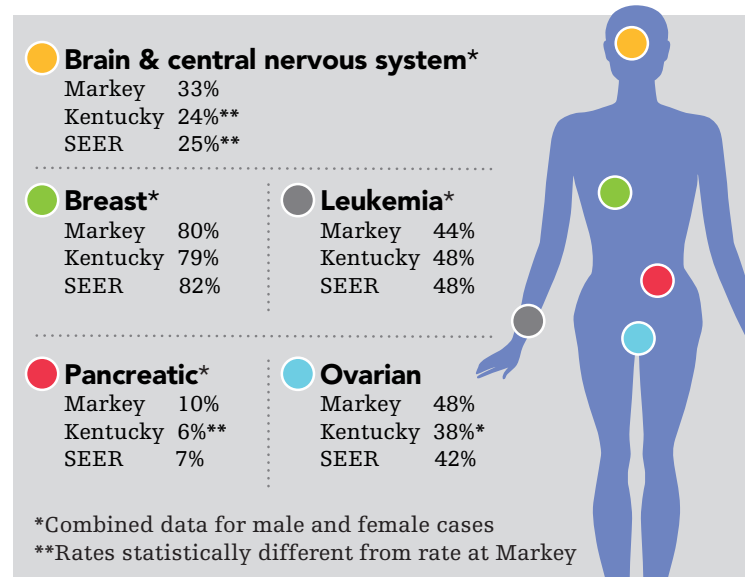
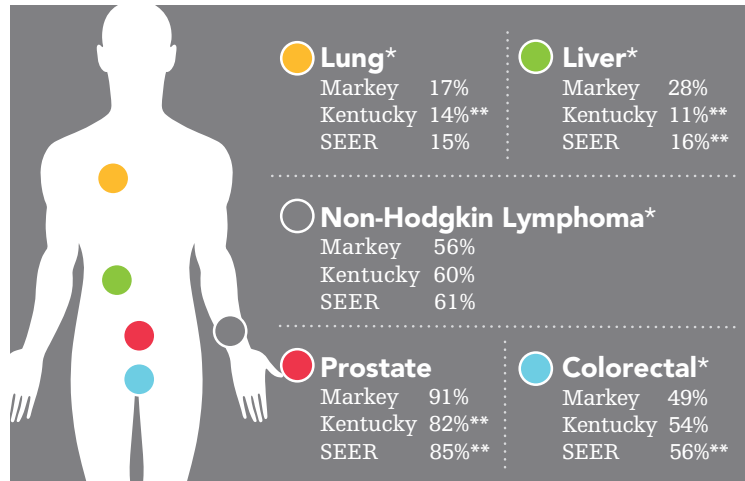
This year, the UK Markey Cancer Foundation welcomed Mike Delzotti, CFRE, as president and CEO. Delzotti joined the foundation from MD Anderson Cancer Center and will lead cancer fundraising initiatives at the UK Markey Cancer Center.



UNIVERSITY OF KENTUCKY
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MARKEY BY THE NUMBERS

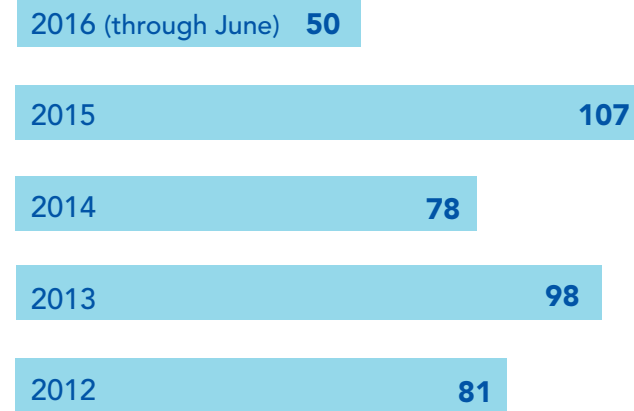
FIVE-YEAR CANCER SURVIVAL



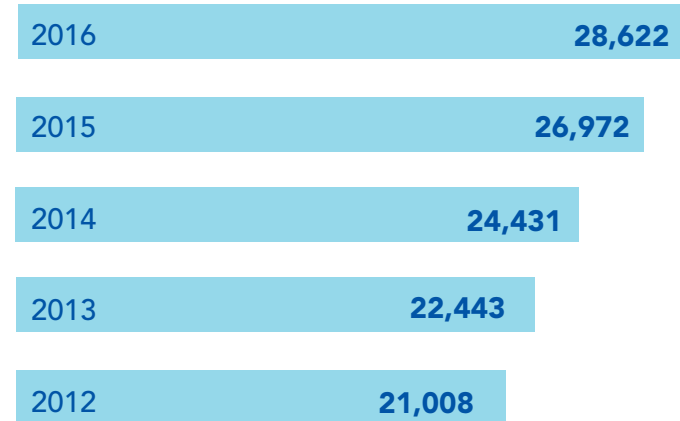
The graphic above shows, for each cancer type, the estimated five-year survival rates of selected invasive cancer tumor sites from 2009-13 (Includes Markey, Kentucky and SEER data). Markey's rates are compared to figures for patients from Kentucky who had the same cancer type and patients in the national SEER database who had the same cancer type.

The SEER database includes 18 cancer registries with high-quality population-based tumor data from states around the U.S. The SEER registries cover approximately 28 percent of the U.S. population, and statistics based on the SEER data have been widely used to represent statistics from the U.S.

Bone & marrow cases by calendar year



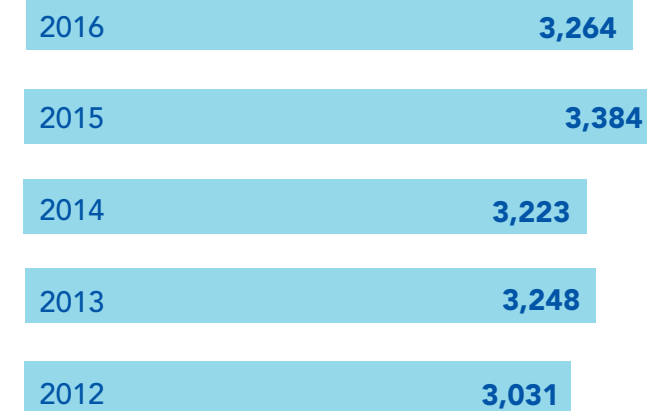
Unique patients (MRN)s neoplasms & hematology by fiscal year



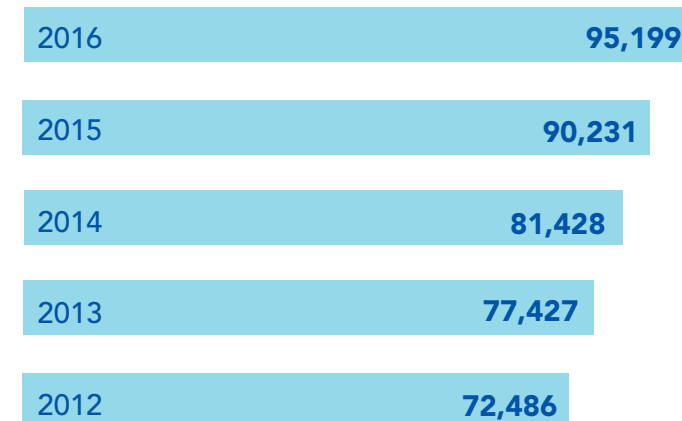
Neoplasms and Hematology visits by gender, inpatient and outpatient by fiscal year

Gender	2012	2013	2014	2015	2016
FEMALE	44,587	47,418	51,381	54,770	56,803
MALE	30,919	33,256	33,270	38,845	41,660
UNKNOWN	11	1			
Total	75,517	80,675	84,651	93,615	98,463

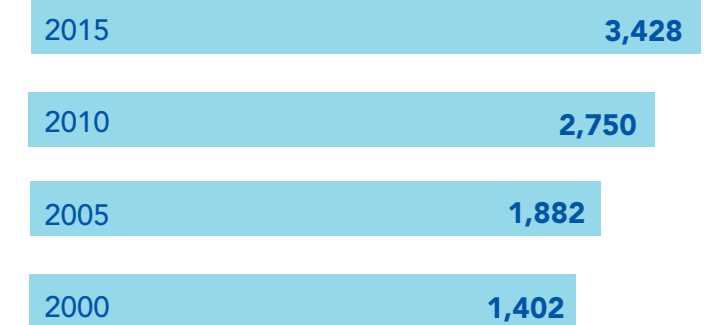
Inpatient neoplasms & hematology visits by fiscal year



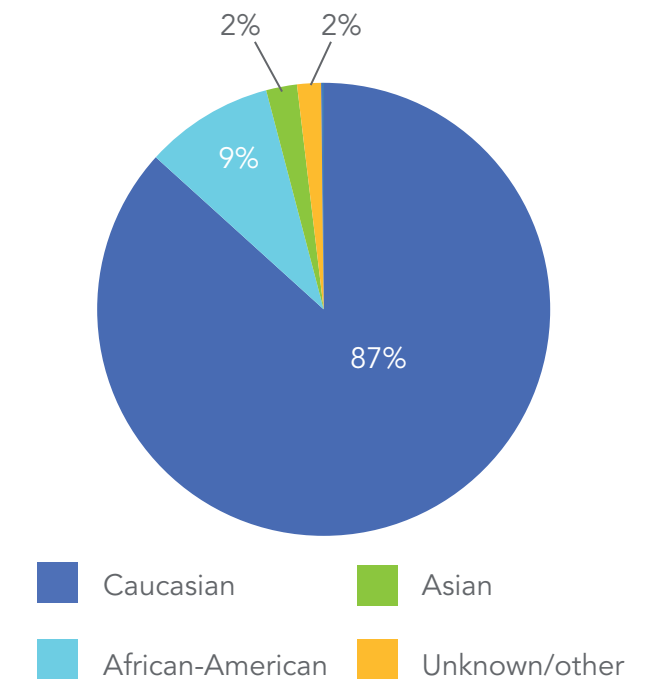
Outpatient neoplasms & hematology visits by fiscal year



Growth in new cancer cases by calendar year

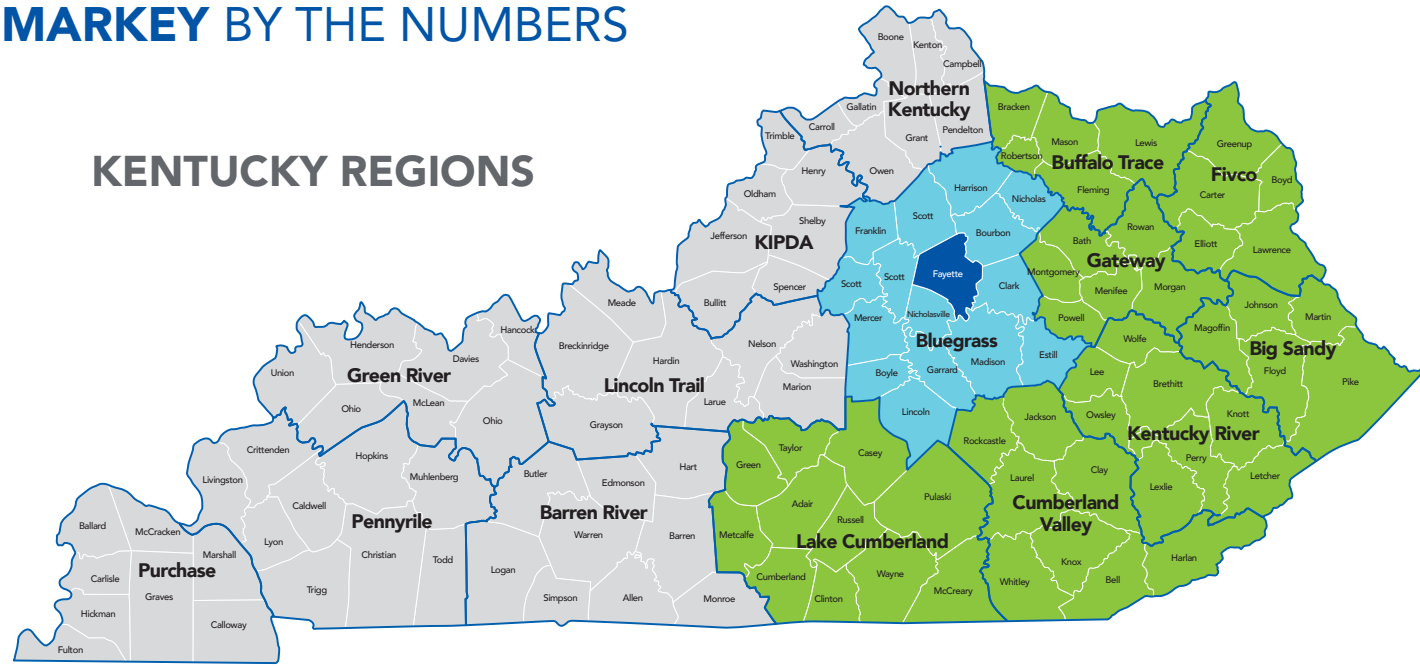


Unique patients by race fiscal year 2016



MARKEY BY THE NUMBERS

KENTUCKY REGIONS



Markey Cancer Center cancer visits by Kentucky Region*, inpatient and outpatient by fiscal year

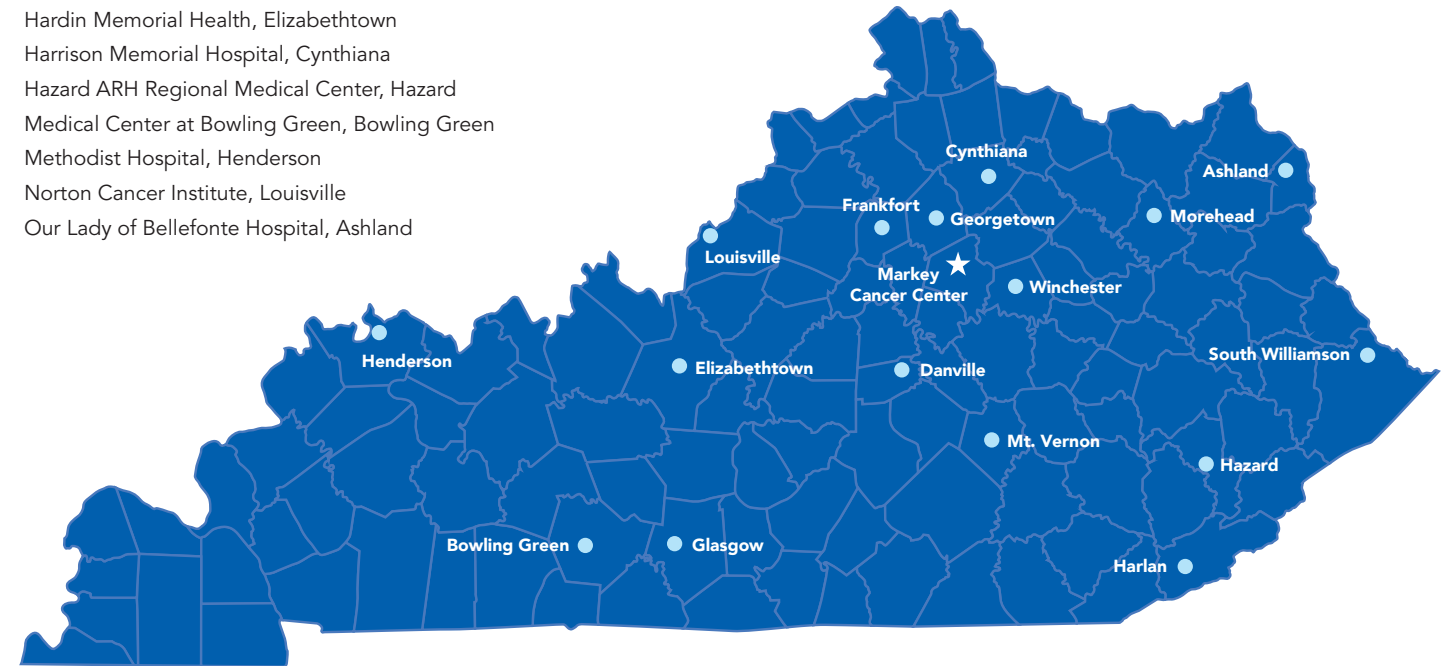
Area	2012	2013	2014	2015	2016
Fayette	26,043	27,309	27,436	29,431	31,611
Bluegrass	22,898	26,443	26,849	28,747	29,944
Cumberland Valley	5,901	5,864	6,904	7,750	8,353
Lake Cumberland	3,854	3,712	4,241	5,476	5,709
Kentucky River	2,805	2,782	3,555	4,527	4,060
Gateway	2,902	3,135	3,554	3,544	3,996
Big Sandy	2,441	2,656	2,955	3,292	3,082
Fivco	1,743	1,667	1,832	2,110	2,361
Buffalo Trace	1,544	1,440	1,538	1,921	1,892
KIPDA	1,015	1,367	1,218	1,198	1,476
Lincoln Trail	660	488	840	1,147	1,306
Northern Kentucky	782	835	1,146	1,013	1,059
Pennyryle	104	213	145	111	323
Green River	126	183	214	339	315
Barren River	188	287	197	253	299
Purchase	58	90	90	132	257
Unknown Out of State	2,453	2,204	1,937	2,624	2,420
Total	75,517	80,675	84,651	93,615	98,463

*Kentucky Area Development Districts (ADD) = Kentucky Region

UK MARKEY CANCER CENTER AFFILIATE NETWORK

16 MEMBERS

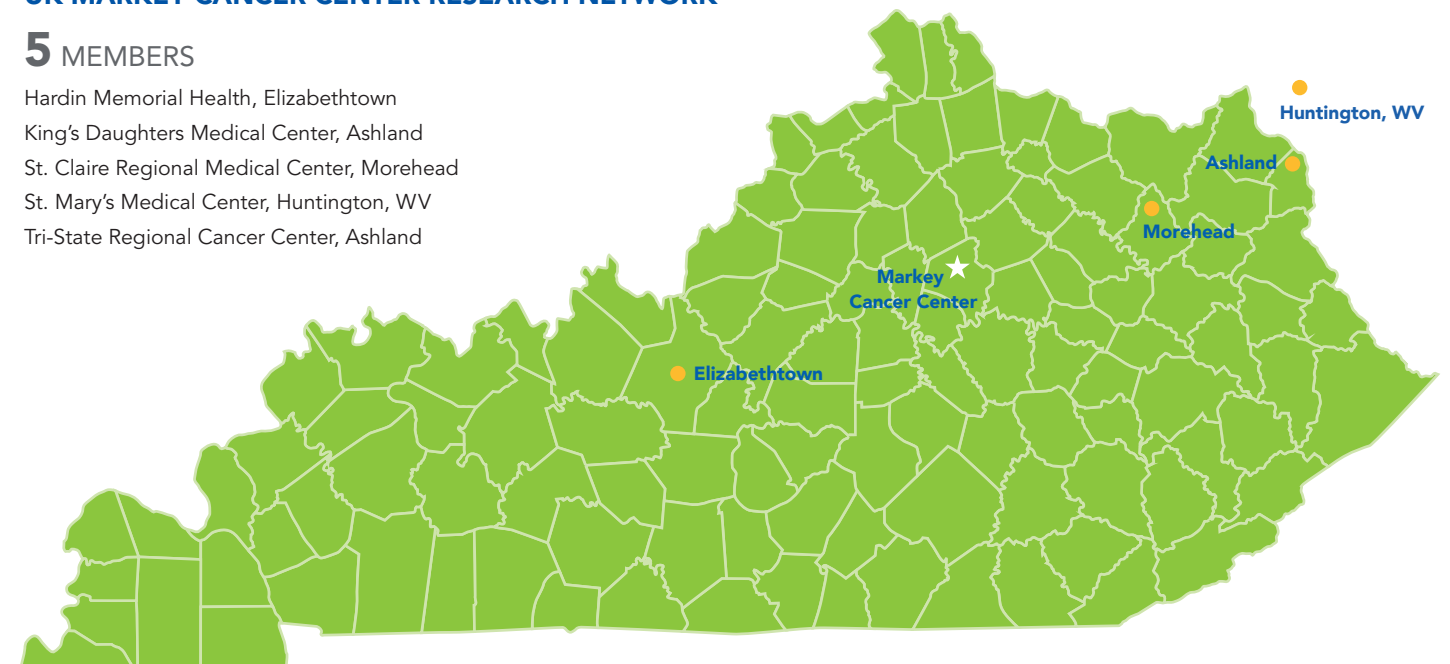
- Clark Regional Medical Center, Winchester
- Ephraim McDowell Regional Medical Center, Danville
- Frankfort Regional Medical Center, Frankfort
- Georgetown Community Hospital, Georgetown
- Harlan ARH Hospital, Harlan
- Hardin Memorial Health, Elizabethtown
- Harrison Memorial Hospital, Cynthiana
- Hazard ARH Regional Medical Center, Hazard
- Medical Center at Bowling Green, Bowling Green
- Methodist Hospital, Henderson
- Norton Cancer Institute, Louisville
- Our Lady of Bellefonte Hospital, Ashland
- Rockcastle Regional Hospital, Mt. Vernon
- St. Claire Regional Medical Center, Morehead
- TJ Samson Community Hospital, Glasgow
- Tug Valley ARH Regional Medical Center, South Williamson



UK MARKEY CANCER CENTER RESEARCH NETWORK

5 MEMBERS

- Hardin Memorial Health, Elizabethtown
- King's Daughters Medical Center, Ashland
- St. Claire Regional Medical Center, Morehead
- St. Mary's Medical Center, Huntington, WV
- Tri-State Regional Cancer Center, Ashland



MARKEY BY THE NUMBERS

The UK Markey Cancer Center, Kentucky's only NCI-designated cancer center, is driven by more than **\$42 million** in research funding. It is made up of **166 team members** in **11 colleges** and **35 departments** across the University of Kentucky campus.

UK Markey Cancer Center Summary of active Funded Projects as of July 31, 2016

Funding Agency (Source)	Total Number of Projects	Sum of Direct Costs	Sum of Total (Direct + Indirect)
NCI	65	\$10,257,451	\$14,228,156
Other NIH	36	\$8,942,481	\$11,666,228
Other Peer Reviewed	25	\$6,180,873	\$8,354,413
Subtotal of Peer Reviewed	126	\$25,380,805	\$34,248,797
Industry Non Peer Reviewed	47	\$2,733,861	\$3,326,123
Other Non Peer Reviewed	48	\$4,201,085	\$4,610,106
Subtotal of Non Peer Reviewed	95	\$6,934,946	\$7,936,229
GRAND TOTAL (All Projects)	221	\$32,315,751	\$42,185,026

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To reduce cancer mortality in our region through a comprehensive program of cancer research, treatment, education and community engagement with a particular focus on the underserved population of Kentucky and Appalachia.

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