2021

Conquest

Johnson Cancer Research Center

Kansas State University

100% of donated funds stay at K-State to support cancer research and education and the university.

$563,146 was awarded in 2020 for faculty and student cancer research and training.

90 faculty researchers are fighting cancer in 20 departments of 5 colleges.

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The fight starts here!

From nanoparticles and stem cells to antioxidants and drug discovery, Kansas State University faculty are conducting the basic and translational cancer research that leads to new treatments and cures, as well as training tomorrow's scientists and medical professionals. To support the Johnson Cancer Research Center's vision to conquer cancer in our time, you can donate online at ***ksufoundation.org/cancer*** or by using the QR code above. With your help, we make a difference! To learn more about how you can support K-State cancer research and education, visit ***cancer.k-state.edu/support*** or call ***785-532-6705.***

On the cover: Kierra Holloman, junior in biochemistry and Cancer Research Award recipient, Kanost Lab

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When thinking back on 2020, we tend to remember COVID-19 with masks, social distancing and quarantines. But I also remember meeting amazing supporters of the Johnson Cancer Research Center. I met many new friends — some in one-on-one meetings and phone calls, others at large events like the *You'll Never Run Alone 5K*. Many became virtual friends at community outreach events like the *Pink Power Luncheon*, where over 80 people met on Zoom. Together, these friends showed me firsthand how many amazing people support us.

Everyone seemed to realize that even in the midst of a pandemic, **cancer does not stop!** As this issue of Conquest demonstrates, support of the Johnson Cancer Research Center continued in 2020. With your help, the Johnson Cancer Research Center funded over $555,000 of cancer research awards. Despite the COVID-19-related restrictions, we sponsored research awards for graduate and undergraduate students and faculty members. We also supported an initial collaboration on cancer prevention and the Pancreatic Cancer Research Collaboration of Excellence, or CRCE. As vaccinations become more available, our laboratories will return to their vibrant activities with students, postdocs and technicians working together to cure cancer.

This Conquest showcases how faculty and students leverage your support into additional funding and advancement. You will read how Dr. Jocelyn McDonald leveraged her JCRC award to obtain a national award to study how brain tumors metastasize to other organs. After initial funding through the Pancreatic CRCE, Dr. Punit Prakash received significant national funding to develop nonsurgical alternatives for removing tumors. As a veterinarian, Dr. Mary Lynn Higginbotham is partnering on a project to treat melanoma while her bone cancer clinical trial is actively enrolling dogs.

Even during COVID, our donors continued to support our center, as exemplified by the Flossie West trustees. Their gift is advancing Dr. Anna Zolkiewska's breast cancer immunotherapy research.

We also show how your support of undergraduates advances their careers. After graduating from K-State in 2004, Kristy Morales went on to become an OB-GYN. Kierra Holloman, a junior in biochemistry, plans to apply her cancer research experience in medical school.

Thank you to everyone who has made this year possible, from donors and faculty to administration and the amazing JCRC staff. I hope to meet more of you soon! Together, we will use basic science research to fight cancer.

Sherry D. Fleming, Ph.D., Director and Fiedler Chair

$4,034,066 has been invested in promising cancer research projects since 2003. But $6,096,895 has been requested.

Biologist's cell movement research could pave way to new brain cancer treatment

By Marcia Locke

One of the biggest problems with cancer cells is that they move away from their original location and invade other parts of the body. This spreading of cancer cells, called metastasis, can be devastating for patients.

Jocelyn McDonald, associate professor of biology at Kansas State University, is working to understand how cells break off from tumors, move through the bloodstream and invade distant organs. She is using the fruit fly as a model organism to identify the genes that drive this process. Fruit fly genes are similar to those in human cancers.

"Tumor cells invade as single cells and as cell groups, or collectives," McDonald said. "We're investigating the mechanisms that drive them to invade collectively, which accelerates disease progression."

Currently, her team is focusing on glioblastoma, the most common malignant brain tumor. According to McDonald, expression of the adhesion gene α-catenin in glioblastoma patients correlates with poor survival. Her team is investigating whether, and how, α-catenin promotes collective invasion and metastasis. They are doing this in both the fruit fly and cultured human glioblastoma cells.

"We believe that α-catenin and associated proteins could be potential therapeutic targets for developing drugs to treat glioblastoma," McDonald said. "This is important because there are very few treatments for glioblastoma and standard care has a very low rate of survival beyond five years."

The Johnson Cancer Research Center provided a $25,000 Innovative Research Award for this work in fall 2019. These awards provide seed money for preliminary investigations that hold great promise for garnering future extramural funding.

McDonald has already leveraged her award into a $938,885 National Science Foundation grant. She and co-principal investigator Brad Olson, associate professor of biology, are conducting the study, "Coordination of collective cell migration in complex tissues." The award also supports science workshops for secondary school girls and a project with K-State engineering students to design and create a tissue-altering device and study its effect on cell group movement.

Training students is important to McDonald. She has mentored 12 undergraduate students and three graduate students since coming to Kansas State University in 2015. This includes three undergraduate JCRC Cancer Research Award recipients and one JCRC Graduate Student Summer Stipend recipient.

"I love working with students and am proud that almost all of mine have continued on to medically related or science-related careers."

"We're really appreciative of the cancer research support," McDonald said. "It helps us to work on projects that initially are difficult to get funded because they need preliminary data. It's also been wonderful to have support to train more undergraduate and graduate students in the lab."

Beyond the classroom

Biochemistry student works on molecular switch to kill cancer cells

By Marcia Locke

Kierra Holloman knew before she enrolled at Kansas State University that she wanted to work with DNA. The ambitious Fort Worth, Texas, native has been working in a laboratory since her freshman year at K-State. Now, the junior in biochemistry is directing her research toward fighting cancer.

Holloman works in the laboratory of Michael Kanost, university distinguished professor of biochemistry and molecular biophysics, under the supervision of Neal Dittmer, research assistant professor in the same department. She was excited to join this team because they work with DNA.

Holloman started out studying the use of double-stranded RNA to alter gene expression. Now, with a Cancer Research Award from the Johnson Cancer Research Center at K-State, she is zooming in on proteins involved in cancer.

Specifically, Holloman is studying proteases and serpins. Proteases are enzymes that break down proteins, and serpins are a type of protein that can inhibit proteases. This is important to cancer research because a protease in humans, called granzyme B, can promote programmed cell death, or apoptosis, in various types of cancer cells. And a protein called SerpinB9, which regulates granzyme B, can interfere with that process, allowing the cancer cells to survive.

The function of SerpinB9 can be blocked, however, by disulfide bonds formed through oxidative stress. So, in her study, "Regulation of protease inhibitors by oxidation of cysteine residues," Holloman is investigating how a serpin can be turned on or off by oxidation reactions. Using an insect serpin similar to human SerpinB20, she is studying how oxidative stress can cause formation of disulfide bonds between serpins and other molecules.

"What's especially exciting is that our method for forming the bonds between the serpin and cysteine or glutathione — if it can translate to human serpins — would be a discovery of a new mechanism for regulating serpins that have a role in cancer cell survival," Holloman said.

Holloman is grateful for this extensive research experience.

"I think the way this most helps me is in my classes," Holloman said. "I'll find myself in class thinking, 'Oh, I've done this in my lab' or 'my mentor talked to me about this.' It has helped my grades a lot, getting that hands-on experience. I also think it gives me a step up in my future because I want to work in a lab and I'm already getting experience using the equipment."

She is also grateful for the financial support of the Cancer Research Award.

"Doing all these classes and exams and lab work is stressful; I don't know how I'd be able to have another job," Holloman said. "And this is nice because it's an academic job, so you're learning at the same time as getting help paying for rent and food."

Making Holloman's research even more meaningful is that her mother is a cancer survivor. A few years ago she had a thymoma, a rare cancerous tumor in the thymus, an organ of the immune system.

"My mom is super-excited about my project," Holloman said. "She said it makes her proud to know I'm working on cancer research."

Holloman attributes much of her interest in laboratory research to her Richland High School forensics teacher.

"Mr. Sanders' class helped me figure out that I liked DNA analysis, which led me to do biochemistry and now cancer research," Holloman said. "I still thank him to this day."

After she graduates from K-State, Holloman plans to go to medical school to study biomedical forensic science. Until then, she'll be working hard to kill cancer cells in the lab.

$200,000 a year is dedicated to training students to do research.

$1,741,000 has been invested in undergraduate research training since 1980.

$7,891,773 in NIH funding was won by our faculty in 2020, often leveraging our seed grants.

Waves over knives

Engineer develops energy-based alternative to tumor surgery

By Marcia Locke

Ideally, cancerous tumors can be removed with surgery. But in many cases, they can't. The tumor is too big or inaccessible, or the patient is unable to tolerate surgery. Minimally invasive alternatives are needed.

Punit Prakash, associate professor of electrical and computer engineering at Kansas State University, is developing technologies for minimally invasive treatment of localized cancers, or tumors. Specifically, his team is developing energy delivery devices and strategies for thermal therapy of cancer. They work primarily with microwave and radio-frequency energy.

$55,814 supported laboratory equipment purchases in 2020. But hundreds of thousands of dollars are needed.

Thermal therapy involves precisely depositing energy into the target tissue where it is absorbed and converted into heat. It can be done in a couple of ways. One is to intensely and briefly heat tumors to destroy them, called thermal ablation. The other is to moderately heat tumors for longer durations to increase their blood flow, which can have various effects that synergize with other therapies.

"With our thermal ablation therapy, the idea is to go in and destroy that solid mass or tissue without as big of an incision, and hopefully even without general anesthesia," Prakash said.

Prakash and collaborators are working to improve tumor ablation technologies currently used with cancers in the liver, prostate, lung, kidney, other organs and bone. The team's image-guided device better addresses the challenges of energy delivery, direction and dosing.

The moderate heating approach stimulates tumors, which typically have irregular blood flow. The increased blood flow could help get more chemotherapy or immunotherapy drugs into the tumor. Similarly, it could amplify radiation therapy within the tumor as well.

To carry out these therapies, Prakash's team has developed a needle-based device about two millimeters in diameter that can be inserted through the skin and into a tumor with guidance from MRI technology.

"The goal is to maximize therapeutic heating of the tumor while preventing thermal damage to critical structures," Prakash said. "Our device radiates the microwaves in a pattern so they localize within and slightly beyond the tumor with minimal disruption or damage to surrounding tissue."

Prakash's team has also made the device capable of shaping the pattern of the energy that is radiated.

"Instead of going off in all directions, it heats only to one side, so clinicians treating close to a critical structure can aim the energy away from it," Prakash said. "This technology is now being translated by a Manhattan-based startup company founded by a recent K-State graduate."

Since MRI also monitors temperature in real time, energy dosing — or measuring and controlling how much the tumor is heated — is intrinsic to Prakash's technology.

"Working in the MRI environment is tricky because of the associated risks, but we are focused on producing a closed-loop treatment that can deliver energy while simultaneously monitoring and correcting it," Prakash said.

Prakash, who leads K-State's Pancreatic Cancer Research Collaboration of Excellence, thinks that his technology offers some hope for pancreatic cancer patients, who are often diagnosed after their tumors are too advanced for surgery. According to Prakash, thermal ablation could shrink the tumors so that they're eligible for surgery and moderate heating could augment nonsurgical therapies.

Prakash appreciates the support he has received from the Johnson Cancer Research Center and has leveraged his awards to garner millions of dollars in extramural funding.

"The JCRC funds are really helpful," Prakash said. "Initially, you might think it's a small amount, but it's critical because it helps you generate the next level of evidence that helps you apply for the bigger funding."

Indeed, Prakash and partners received a $1,321,648 National Cancer Institute grant to develop a bronchoscopic microwave ablation system for lung tumors. According to Prakash, microwave needles are effective, but since lungs can collapse, a safer approach to lung tumors may be from inside the airways, which are difficult to navigate. He and collaborators have developed a system that is showing success in animals and may advance to human testing by next year. This work has resulted in multiple pending patent applications.

"This has been really exciting for us," Prakash said. "It's not every day you're involved in developing a new technology from concept to clinical translation."

75% of undergraduate Cancer Research Awardees go on to graduate and professional schools, and many of the rest go into the biomedical workforce.

K-State alumna, OB-GYN says student research experience opened doors to success

By Marcia Locke

Kristy Morales

From delivering babies and performing surgeries to conducting wellness exams and counseling nervous moms-to-be, Kristy Morales, an OB-GYN and a fairly new mom herself, leads a busy life helping people. The 2004 Kansas State University graduate in biology and pre-medicine works in Texas and she credits her undergraduate research experience with helping her become a doctor.

Morales grew up in Manhattan, Kansas. She remembers walking to K-State's Hale Library with her mom, a graduate student at the time, and admiring the beautiful campus with its striking limestone buildings. She loved Manhattan and after graduating from Manhattan High School, she stayed to attend K-State.

That was one of several decisions that set Morales up for success. With thoughts of going into psychology, she also listened to her advisor, Larry Williams, and majored in biology, which would prepare her for medical school in psychology or anything else. She also took the advice of Anita Cortez, then-director of the Developing Scholars Program, to get involved in research, which would help her no matter what she went into.

They were right. Morales loved biology and soon ruled out psychology, added pre-medicine, joined a research team and aimed for medical school.

Morales worked in the laboratory of Lorena Passarelli, professor of biology. They studied baculovirus, a virus used in biomedical research as a vector to produce vaccines, diagnostic agents and therapies.

Morales received two Cancer Research Awards from the Johnson Cancer Research Center. The awards provide funding to support faculty-mentored research experiences for students. She investigated a protein complex involved in viral replication, seeking insight that could help optimize baculoviruses as gene therapy vectors for treating cancer and as powerhouses for vaccine development.

"Doing that research gave me experience working as part of a team, critically reading journal articles, and presenting and publishing scientific work," Morales said. "It was a good experience overall. It opened doors for networking and it helped me a lot in med school to have that base of knowledge from the lab."

In fact, during her first year of medical school, her laboratory mates remarked on her exceptional skills.

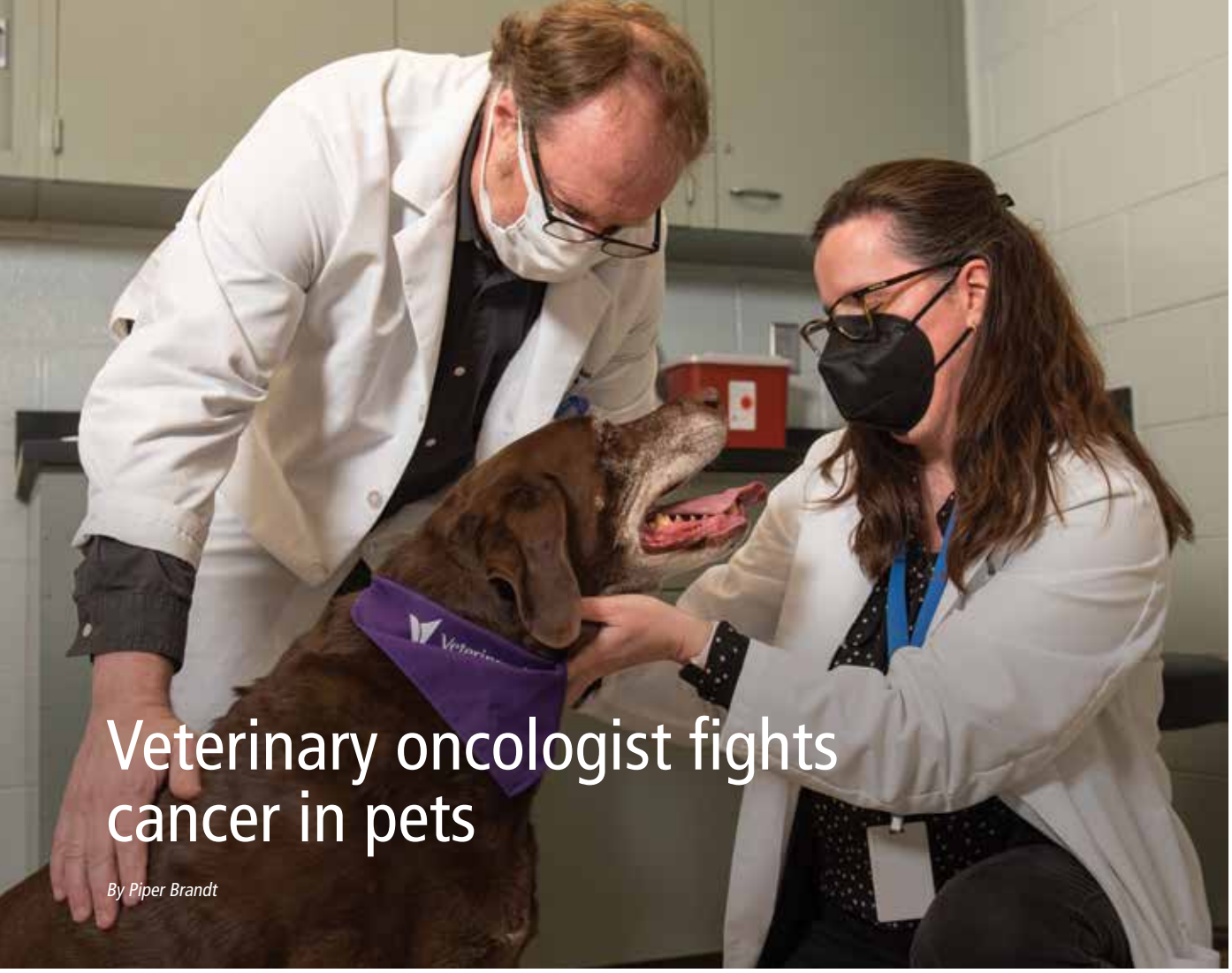
"They asked me, 'How are you so good at that? You're using those pipettes like a boss!'" Morales said. "I told them I did it in undergrad. I wasn't this good when I first started; I just know how to use the machine."

After earning her medical degree in 2008 from Creighton University School of Medicine in Nebraska, Morales did her medical residency at Saint Louis University Hospital in Missouri and then served four years as an OB/GYN in the U.S. Air Force. Meanwhile, her husband started medical school too. In 2017, his residency took them to Texas.

Now a busy OB-GYN at South Texas Health Systems Women's Corner in Edinburg, Morales looks back with gratitude for the philanthropy that helped her get there.

"The Cancer Research Award from the Johnson Cancer Research Center made it possible for me to finish my research project and continue pursuing my career," Morales said. "Without that support and experience, I don't think I would've been as strong a candidate for medical school."

Things are going well for Morales and her family in Texas. But she will always treasure her time at K-State — in the Division of Biology and the lab — and is grateful for all the doors it opened.



Veterinary oncologist fights cancer in pets

By Piper Brandt

Programs to advance K-State cancer research and education are made possible by private donations.

When a loved one is diagnosed with cancer, it can be a challenging and painful process for everyone involved, even when the loved one happens to be covered in fur.

Mary Lynn Higginbotham, associate professor of clinical sciences at Kansas State University, is working with her colleagues in the College of Veterinary Medicine to find innovative ways to treat cancer in pets.

Around 1 in 4 dogs and 1 in 5 cats will develop some form of cancer in their lifetime. Although cancer is prevalent in older pets, Higginbotham wants to ensure it doesn't always have to be a life-limiting disease.

One of Higginbotham's current research projects, in partnership with Rob DeLong, associate professor in the Nanotechnology Innovation Center, is centered on treating melanoma in dogs. Both Higginbotham and DeLong are members of the Johnson Cancer Research Center.

"The goal of the melanoma research is to compare the dog and human forms of melanoma, particularly the triple-wild type, mucosal and drug-resistant melanomas in people, and use the dog as a model for evaluation of novel treatment or delivery of treatments via nanoparticles," Higginbotham said. "Dr. DeLong and I, along with all of the oncology group at the Veterinary Health Center, have worked together to justify the dog as a model, and on in vitro work comparing the tumor cells and the effects that various nanoparticles have on the melanoma cells in culture."

By comparing canine melanoma to human melanoma, Higginbotham and DeLong hope to gain fundamental information about how various nanoparticles and drugs interact and impact the growth of melanoma cells.

"This project is very near and dear to our hearts," DeLong said. "We hope it will be able to help dogs and eventually humans with these difficult types of cancer."

The oncology group is also currently involved in a multi-institutional clinical study sponsored by Elias Animal Health, a Kansas City-based company, intended to help improve the survival rate of dogs with bone tumors.

"The study will compare the outcome of dogs with osteosarcoma treated with standard of care therapy, which is amputation followed by carboplatin chemotherapy, to dogs with osteosarcoma treated with the ELIAS Cancer Immunotherapy, or ECI®," Higginbotham said. "ECI® is a vaccine-enhanced adoptive cell therapy."

The study is comprised of 11 sites, two of which are academic institutions, including K-State. These sites have enrolled dogs with osteosarcoma into a clinical trial where they were treated with the ECI® therapy.

Higginbotham says the overall goal of the study is to improve the survival of dogs with osteosarcoma as compared to standard of care therapy and to avoid or minimize the need for chemotherapy or radiation therapy, which have the potential to create negative side effects.

No matter the diagnosis, Higginbotham wants to make sure treatment is as effective and painless as possible, allowing pets to live longer and happier lives. While dogs are said to be a human's best friend, it will be quite fortuitous if it turns out that humans are dogs' best friends when it comes to treating canine cancers.

Self-proclaimed 'medical miracle' shares her story at Pink Power Luncheon

By Marcia Locke

After surviving four cancers in eight years, Liz Benditt thinks of herself as a medical miracle.

Benditt shared her story at the 11th annual Pink Power Luncheon for breast cancer awareness on Oct. 23, 2020. The virtual event, co-sponsored by the Johnson Cancer Research Center and Susan G. Komen Kansas and Western Missouri, was attended by more than 80 people.

With a pink brick wall Zoom background and a friendly smile, Benditt gave her inspirational presentation "The Finish Line is the Starting Line." She spoke openly about those grueling years of cancer treatments, side effects and feeling burdensome, and about turning it all into a new beginning.

In 2009, at the age of 36, Benditt was diagnosed with melanoma, the most deadly form of skin cancer. The fair-skinned mother of two young children faced the possibility of dying within a year. Fortunately, the cancer had not spread to her lymph nodes and the surgery went well.

The following year, however, she was diagnosed with another cancer — thyroid cancer. That surgery led to a condition called hypoparathyroidism, which causes mineral imbalances, and earned her an extra two weeks in the hospital. It took years of medical and diet challenges to feel healthy again.

Five years later came the basal cell skin cancer. It was not a very threatening cancer, but facial plastic surgery was tricky and very painful.

In 2017, Benditt faced her fourth and worst cancer experience. Although the breast tumor was detected early, meaning successful treatment was promising, the lumpectomy surgery and radiation were very difficult. She was in pain and felt her weakened body failing her.

Adding to her frustration was the struggle to find resources to help her recover more comfortably. She didn't need pink ribbons, sassy T-shirts and flowers; she needed aluminum-free deodorant, burn salves and a seat belt mini-pillow to prevent chafing. Moreover, with a lighter appetite and a family of picky eaters, gifts of heavy casseroles and other foods, though deeply appreciated, were not always useful.

"The problem with most cancer treatments is that patients don't know what they're going to need to help them self-soothe until they need it right away," Benditt said. "And I wondered, where is the resource to help cancer patients proactively plan for treatment and recovery?"

At her post-treatment "Finish Line" party, the idea for Balm Box was born. When the COVID-19 pandemic forced a break from other activities, Benditt, a marketing professional, launched her new business. The unique, web-based boutique now offers products to make life a little easier for breast cancer patients undergoing treatment.

"Maybe there is some crazy kismet in the universe," Benditt said. "The past 10 years of cancer treatments leading me to the launch of something great.

"Sometimes the finish line is actually the starting line."

The *Pink Power Luncheon* is one way the Johnson Cancer Research Center goes beyond research to serve the community, working to inform people about cancer and risk reduction, and, ultimately, decrease breast cancer mortality through education.

Presentations, tours, events and information are provided to educate about cancer, risk reduction and research.

Lower Your Risk of Breast Cancer

K-State wants Kansans to know that some risk factors for breast cancer are controllable. The Johnson Cancer Research Center and K-State Research and Extension provide evidence-based information in their new "Lower Your Risk of Breast Cancer" brochure. It explains how to reduce the risk of developing or dying from breast cancer. It can be downloaded from the *JCRC website* and printed copies can be ordered from the *KSRE bookstore*.

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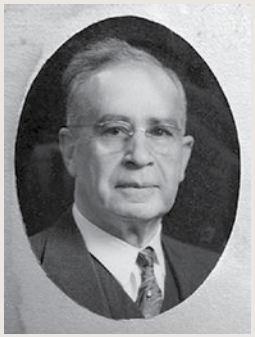
Leaving a legacy

Flossie E. West Trust creates new paths for breast cancer research and honors namesake

Every gift helps, and generally more than 95% of gifts are less than $1,000.

By Dalton Burton



Lyman West

Getting a cancer diagnosis is news no person wants to receive. The physical and mental pain that goes along with a cancer diagnosis can be a brutal burden for anyone to bear. Cancer does not discriminate. It affects millions of men, women and children worldwide and remains at the forefront of the medical industry's research priorities.

The Flossie E. West Trust of Augusta, Kansas, was established in the 1960s by Lyman West, the widower of Flossie, to create funds that support finding new treatments for breast cancer, which Flossie had. To date, the Flossie West Trust has given $656,000 to the Johnson Cancer Research Center of Kansas State University.

"The Flossie West Memorial Trust was set up in the '60s to fund cancer research after Flossie West died of cancer," said Dave Bisango, K-State alumnus and one of the three trustees managing the trust. "Each year, the trustees provide grant research funding and evaluate the effectiveness of the research that is done throughout the year. We have been very pleased with the results of the research through Kansas State University."

The trust is currently supporting the groundbreaking research of Anna Zolkiewska, professor of biochemistry and molecular biophysics. Her team studies breast tumor-infiltrating immune cells and how they help destroy breast cancer cells. They hope their findings will not only advance breast cancer research but also provide new and innovative therapeutic treatment options to patients.

"A cancer patient's own immune system can be the most powerful weapon to fight the disease," Zolkiewska said. "New approaches to boost anti-tumor immunity are effective in treating several types of cancer, but these immunotherapies have been less successful in breast cancer. We are working to understand why so many breast tumors do not readily respond to immunotherapies and to develop better immunotherapies."

Currently, Zolkiewska and her fellow researchers are focused on applying to the National Institutes of Health's National Cancer Institute for an even larger grant to continue their research.

"Without the help of the Flossie West Trust, it would be very difficult to even consider accomplishing this goal," Zolkiewska said. "The Flossie West Trust has been vital in providing us with the tools necessary to continue our research and reach for higher goals."

Anna Zolkiewska

Coupled with the research is a desire to help people and rid the world of a disease that takes an awful toll.

"The main reason behind the Flossie West Trust is to honor her legacy, and the best way we can do that is to continue funding this great research in hope of eliminating breast cancer once and for all," Bisango said. "The reason why I and my fellow trustees got into this wasn't for the recognition; it was to honor Flossie's legacy and let others who are in a similar situation know they are not alone."

Philanthropic support is making a difference now and well into the future. Much of the support for the Johnson Cancer Research Center comes from privately donated funds to support about 90 K-State cancer research teams. This funding often provides the leverage needed to win larger grants that will provide dividends over the years in K-State's fight against cancer.

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