Conquest

Johnson Cancer Research Center

Kansas State University

90 faculty researchers are fighting cancer in 17 departments of 5 colleges.

$500,000 a year is awarded to support cancer research and education.

$704,000 is what we awarded in 2013 — a record amount, thanks to some special gifts!

95% of your gift goes directly to cancer research while 5% is used to advance K-State.

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, simply use the enclosed envelope to send your gift, or donate online at ***www.found.ksu.edu/cancer.*** With your help, we make a difference! To learn more about how you can support K-State cancer research and education, contact David Spafford at ***800-432-1578*** or ***davids@found.ksu.edu.***

On the cover: Masaaki Tamura and his students.

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Welcome to the 2014 *Conquest* magazine showcasing outstanding cancer research conducted at Kansas State University. As K-State takes steps to become a Top 50 public research university, the Johnson Cancer Research Center is contributing to the visionary plan's thematic goals and increasing excellence in these areas by:

- **Creating a culture of excellence that results in flourishing, sustainable and widely recognized research.**

Our 90 affiliated scientists have outstanding credentials by almost any criteria, including publication, extramural funding and internationally recognized research. Our support enhances their capacity to excel. Please take a look at our stories about John Tomich, biochemistry; Masaaki Tamura, anatomy and physiology; and Brian Lindshield, human nutrition.

- **Promoting undergraduate student participatory learning and graduate student scholarly excellence.**

We're training future researchers. Each year we give 50 undergraduates the opportunity to do faculty-mentored research and offer scholarships that help K-State recruit and support outstanding health sciences students. We offer graduate students summer research stipends and funds to attend professional meetings. Read our stories about plant pathology graduate student Derek Schneweis and K-State biology professor and past student awardee Sherry Fleming.

- **Contributing to the public good through engagement, extension, outreach and service.**

We inform the public about cancer and research in multiple ways, regularly collaborating with non-university partners. We offer many cancer-education materials, presentations and community events.

- **Fostering a work environment that encourages creativity, excellence and high morale in faculty and staff.**

Affiliation with our center has been a potent faculty recruitment tool for the university. Our support for research projects, equipment and personnel — at a time when extramural funding is extremely competitive — and our fostering of on- and off-campus collaborations have resulted in impressive research productivity.

- **Providing facilities and infrastructure that meet evolving university needs and are an asset.**

Helping faculty get cutting-edge equipment is one of our major goals. Not only do we offer funds for equipment, but faculty who win our awards often experience greater success with their extramural applications.

The center's impact in all of these areas is made possible by the generous support of our donors. In this issue, we feature Mason and Nancy Wolfe, a mother-daughter team whose entrepreneurial and philanthropic spirit are not only admirable but truly making a difference for K-State cancer research.

We sincerely thank you for taking an interest in K-State cancer research and invite you to consider joining our fight.

Rob Denell

Director

Solitary confinement

Newly developed molecule may protect cancer patients by storing harmful ions released during radiation treatment

By Greg Tammen

Cancer treatment may soon have a new tool in the form of microscopic, nontoxic storage lockers.

In 2012, John Tomich, a biochemistry professor affiliated with the Johnson Cancer Research Center, and his research team designed a thin membrane-bound, hollow capsule from two related sequences of amino acids. When combined, the sequences form a very small, hollow particle similar to a bubble.

"We found that the two sequences come together to form a thin membrane that assembles into little spheres, which we call capsules," Tomich said. "While other vesicles have been created from lipids, most are much less stable and break down. Ours are like stones, though. They're incredibly stable and are not destroyed by cells in the body."

Initially, Tomich and colleagues looked at filling the capsules with anticancer drugs and directing them to tumors — similar to biological cruise missiles. The capsules, however, were unable to be recognized by the cell's own degradative machinery, which would have broken down the capsules and released the anticancer drugs in the tumor.

This prompted Tomich to look at using the capsules for containment rather than transport.

Currently, Tomich is conducting research with Ekaterina Dadachova, a radiochemistry specialist at Albert Einstein College of Medicine in New York. They are testing the capsules' ability to store harmful isotopes for controlled radiation release during radiation treatment of tumors.

"The problem with current radiation therapies is that they lead to the release of daughter ions in the body," Tomich said. "Those radioactive ions are generated during release of an alpha particle that comes off at nearly the speed of light. On collision, it destroys DNA and whatever vital cellular components are in its path. The escaped daughter ions can end up in places you don't want them, like bone marrow, which can then lead to leukemia and new challenges."

Tomich and Dadachova tested the capsules against alpha-emitting radioactive particles — one of the most effective forms of radiation therapy. Capsules were introduced into the body and migrated to the outside parameter of the nucleus of healthy cells.

Researchers found that during radiation therapy the radioactive isotopes were trapped inside the capsules, effectively blocking uptake in certain nontarget tissues and protecting them from harmful radiation that would otherwise have been released into the body. Additionally, the capsules acted as secure, long-term storage for the radiation because the capsules do not break down — even if the cell dies — and are not recognized as a threat to be attacked by the body's defenses.

Tomich said that more studies are needed, particularly in the area of adding targeting molecules to the surface of the capsules. He anticipates that this new approach will provide a safer option for treating tumors with radiation therapy.

Tomich also is working with multiple U.S. research groups as a way to explore other potential applications for the capsules.

"These capsules are easy to make and easy to work with," Tomich said. "I think we're just scratching the surface of what we can do with them to improve human health and nanomaterials."

$2,037,000 has been invested in promising new cancer studies since 2003, but $3,450,000 was requested.

Fighting ever fighting

Student researcher conquers cancer in the classroom and community

By Jennifer Tidball

As a child, Derek Schneweis always knew what he wanted to do when he grew up: cure cancer.

Throughout his childhood, he had seen firsthand the devastating effects of cancer. After his fifth-grade teacher died from melanoma and his aunt died from breast cancer, Schneweis knew he wanted to make a difference and save lives.

Curing cancer was a goal he maintained when he became a student at Kansas State University. While he entered college on a premed track to become a doctor, he quickly realized the important role of research in fighting cancer and decided to pursue a career in research instead of practicing medicine.

"As I went through college, I realized I could do more and help more people through research," said Schneweis, who is from Monument, Colo.

As an undergraduate in biology and anthropology, he received two Cancer Research Awards from the Johnson Cancer Research Center to do research in plant pathology. Today, he continues his basic cancer research as a doctoral student in plant pathology.

Basic cancer research is the first step in fighting cancer, Schneweis said, and his own research is his way of contributing to cancer's cure.

As an undergraduate, he used the Cancer Research Award to study the innate immune response. He investigated the interaction among the western flower thrips, tomato spotted wilt virus and a variety of plants. The interaction among plant, virus and insect is interesting, Schneweis said, because the virus infects both the plant and insect, but the insect does not show any signs or symptoms of illness.

The undergraduate work led to his doctoral research with Dorith Rotenberg, associate professor of plant pathology. Schneweis is studying the innate immune response on a large scale through global transcriptomics. By combining computer science and biology, he is analyzing thousands of genes to understand virus interaction with the host.

Several human viruses, including Epstein-Barr virus, HPV and hepatitis B and C viruses, have shown to cause or contribute to the development of cancer. By understanding what genes change during viral infection, Schneweis wants to identify how the insect harbors the virus but shows no signs of illness.

"Without the funding from the Johnson Cancer Research Center, I never would have achieved the freedom, the recognition or the chance to do the research I'm doing now," Schneweis said. "That support is what has made my research career possible."

Schneweis also is fighting cancer through Cancer Fighters, a student group that helps the center in various ways. Schneweis recently completed two years as the group's president. Under his leadership, the group evolved to include 10-15 core members from numerous disciplines: journalism, anthropology, psychology and biology, among others.

Members volunteer at center fundraising and outreach events, where they interact with people throughout the Manhattan community. Schneweis finds the interaction with community members especially rewarding because he can share his work with others.

"It's really touching to show someone your research and to see it in their eyes that they know it matters," Schneweis said. "That's when you know you are making a difference."

Programs to advance K-State cancer research and education depend on private donations.

Taking aim

Researcher combats cancer with targeted therapies

By Jennifer Tidball

Masaaki Tamura is turning to the laboratory to improve cancer treatment.

Tamura, associate professor of anatomy and physiology, is creating targeted cancer therapies to help the thousands of people diagnosed with breast, lung and pancreatic cancers each year. Together these cancers contribute to more than 42 percent of cancer-related deaths in the U.S.

"We want to generate a safe, patient-friendly therapy," Tamura said.

Two of Tamura's projects include developing a nanoparticle-based gene therapy to treat cancer and creating a cancer therapy that uses umbilical cord matrix stem cells.

During the nanoparticle research, Tamura's team discovered that some peptide nanoparticles are good gene delivery tools for treating lung cancer. Such a method could be safer than current chemotherapy practices. They are collaborating with University of Kansas researchers to develop and commercialize this alternative to chemotherapy. A National Institutes of Health grant is supporting the work.

Cancer develops from our own bodies, Tamura said, which makes it very difficult for traditional chemotherapy to distinguish cancer cells from healthy cells. Tamura has found a safer therapy in cationic peptide nanoparticles. A peptide is a chemical compound that is composed of a chain of two or more amino acids.

The small peptide helps transfer an important gene called angiotensin II type 2 receptor, which is important for maintaining cardiovascular tissue and brain function. When the receptor gene is attached to peptide nanoparticles — which guide the gene directly to the lung cancer cells — the combination can kill cancer cells without damaging healthy cells. This targeted therapy can be beneficial not only for lung cancer, which contributes to nearly 30 percent of cancer-associated deaths, but also for difficult-to-treat cancers, such as ovarian or pancreatic cancers.

"The peptide itself is a very safe material and has no harmful effects," said Tamura, who is one of the first researchers to use the peptide for cancer treatment. "The gene is actually already expressed in our body — everybody has this gene."

With such a safe material, the lungs themselves could help with delivery. The researchers hope to develop a peptide spray that can be inhaled into the lungs and travel through the circulatory system to other cancerous tissue.

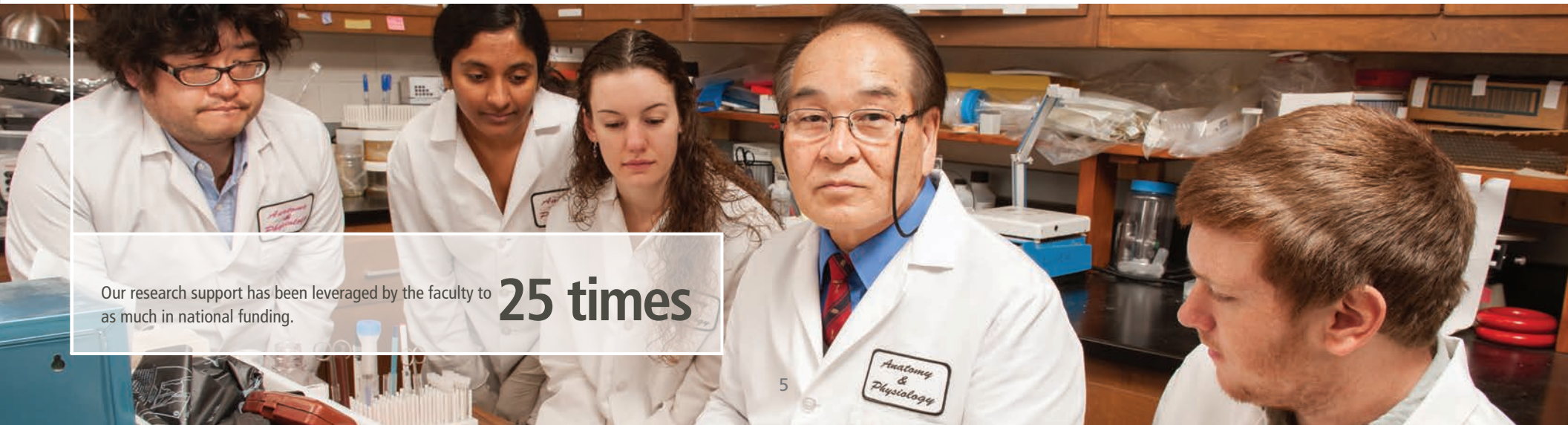
For another cancer therapy project, Tamura collaborated on the discovery of umbilical cord matrix stem cells and their effectiveness at treating cancer. The Kansas State University research team — which included Mark Weiss and Deryl Troyer, both professors of anatomy and physiology — found that these stem cells can migrate to both primary cancer tissue and metastasized cancer. The stem cells can kill cancer cells, such as breast, lung and pancreatic cancer cells.

Kansas State University and the stem cell research group have received a patent addressing their procedure to gather stem cells from umbilical cords — a less controversial source of stem cells. These stem cells do not generate any additional tumors and can travel deep inside the inflammatory tissue where cancer is located. The stem cells could also be used to deliver anticancer drugs directly to cancer cells, leaving healthy cells unharmed.

A $500,000 Kansas Bioscience Authority grant supported the collaborative work. The researchers are now further developing the stem cell research for clinical trials.

While Tamura is committed to conquering cancer, he also is committed to training the next generation of researchers. In his laboratory, he is mentoring three undergraduate students, one graduate student and a postdoctoral researcher. His goal is to help all of his students publish their research.

"Research starts from our own curiosities," Tamura said. "We are trying to tell students to look carefully and be sincere in science. Then they will enjoy it and discover something from it."



Our research support has been leveraged by the faculty to as much in national funding. **25 times**

$28,000 was provided for laboratory equipment in 2013, but hundreds of thousands of dollars are needed.

From drugs to dietary supplements

How a nutritionist is fighting prostate cancer

By Jennifer Tidball

A Kansas State University nutritionist is helping men reduce their risk of prostate cancer, one of the most common forms of cancer among men in the U.S.

Brian Lindshield is an assistant professor of human nutrition, a 2003 K-State alumnus and former undergraduate student cancer researcher with the Johnson Cancer Research Center. He is taking two approaches to preventing and treating prostate cancer: He is researching cancer-fighting drugs, and he is studying dietary supplements.

Lindshield has received financial support from the Johnson Cancer Research Center and from the National Institutes of Health Center of Biomedical Research Excellence, or COBRE, for studying epithelial function in health and disease.

Cancer-fighting drugs

One of Lindshield's projects focuses on two drugs — finasteride and dutasteride — used to treat benign prostatic hyperplasia, or BPH, which is an enlargement of the prostate.

Both drugs inhibit enzymes that convert the male hormone testosterone to a more potent form, called dihydrotestosterone, or DHT. Finasteride inhibits one of these enzymes, while dutasteride inhibits both of these enzymes.

Lindshield's team compared finasteride and dutasteride to see if one was a more effective preventative drug to stop cancer's formation or a therapeutic drug to treat already developed cancer.

They found that the most effective drug combination was dutasteride as a therapeutic drug when cancer had already formed.

Other results included:

- Finasteride did not provide much benefit, no matter whether it was given as a preventative or therapeutic drug. Finasteride also increased the risk of developing high-grade cancer.
- Dutasteride did provide some benefit as a preventative drug, but it also increased the risk of a cancer progressing to a high-grade stage.

"It's kind of a double-edged sword," Lindshield said. "These drugs can lower the risk of developing prostate cancer, but they also might lead to worse outcomes for men who do develop the disease."

The research appeared in the journal PLOS ONE and involved collaborators Alexander Opoku-Acheampong, doctoral student in human nutrition, Ghana; Dave Unis, doctoral student in biology, Manhattan; and Jamie Henningson, assistant professor at the Kansas State Veterinary Diagnostic Laboratory.

Lindshield and Opoku-Acheampong are now measuring different proteins to understand why the timing of the drugs makes a difference in effectiveness.

Dietary supplements

For a second project, Lindshield's team is studying a palm tree-like shrub called saw palmetto and its effect on reducing prostate cancer risk.

Many men take saw palmetto supplements because they can benefit prostatic health and inhibit the same enzymes as finasteride and dutasteride, Lindshield said.

Lindshield and Kavitha Penugonda, doctoral student in human nutrition, India, gathered 20 kinds of saw palmetto supplements — including liquids, powders, dried berries and tinctures — and measured their fatty acid and phytosterol content. The researchers recently published their results in the journal Nutrients.

The next step is to study whether differences in fatty acid and phytosterol content can increase or decrease saw palmetto's effectiveness at reducing prostate cancer risk.

"Our hypothesis is that the fatty acids, especially the medium chain saturated fatty acids, might be responsible for saw palmetto's effectiveness," Lindshield said. "We want to look at how the different supplements affect growth of prostate cancer cells and inhibit the enzymes that produce DHT."

Mason's Wish

Girl starts foundation to help her dad, others beat cancer

By Sheila Ellis-Glasper

It all started with one little girl's wish: Find a cure for cancer.

Now, this girl and her family have raised almost $100,000 for Kansas State University cancer research with the help of their community and friends.

Mason Wolfe was 9 years old in 2007 when she learned her father, Fred Wolfe, a 1993 K-State alumnus, had lung cancer.

In an effort to help find a cure for cancer, the family started Mason's Wish, a foundation to raise funds for K-State's Johnson Cancer Research Center.

"We will keep going until a cure for cancer is found," said Nancy Wolfe, Mason's mother and Fred's wife, who has worked with Mason to coordinate every aspect of Mason's Wish. She is also a member of the cancer research center's advisory council and a 1990 K-State alumna.

"At first our whole family felt hopeless, but starting Mason's Wish was a way to get our minds off of it and know that we were doing something to help Dad and other families," said Mason, who is now 16.

For their first fundraiser, the family sold candles at a parent-teacher conference night at Mason's elementary school, and made almost $3,000. That fundraising strategy stuck, and over the past eight years, they have sold hundreds of Sugar Shack Country handmade candles.

Mason's Wish has also benefited from an annual golf tournament sponsored by Western States Fire Protection, which raises more than half of the charity's funds.

Mason was awarded the Gold Barnum Award from Ringling Bros. & Barnum and Bailey and received $1,000 to fund a community project or fundraiser. She used the money to design "Hope in a Cure" cancer awareness T-shirts, and the family has sold almost 400 of them.

The Wolfes also have an annual garage sale at their home that raises about $2,000 each year. G.E. Johnson, Fred's employer, donates to the garage sale and other Mason's Wish fundraisers. The company gives each employee a candle during the holidays, and employees have participated in and donated to the golf tournament.

In 2008, Fred's lung cancer spread to his brain and he developed several brain tumors. His doctor gave him only a few months to live, but Fred has persevered. He has good days and not so good days, but is still optimistic about his condition, Nancy said.

"It's all about attitude," Nancy said. "Fred says, 'I'm not going to waste a day complaining.'"

He continues to work, although some days he works from home. The brain tumors have affected his sight and he is no longer able to drive, but he carpools with a co-worker who lives nearby. Mason takes pride in driving her father around to run errands.

Nancy believes Mason's Wish has strengthened her family's faith and brought them closer together.

When Fred was first diagnosed with cancer it dominated the Wolfes' lives, she said. Over time, they have continued to live their lives and focus on the time they have together now, not what might happen, she said. Family activities include making trips to K-State football games and alumni activities.

Mason balances fundraising with school. She has been recognized for her heroic efforts by a Denver television station, and manages to maintain a 4.0 grade point average and play on her high school's varsity lacrosse team.

Inspired by all the doctor appointments, scans and x-rays she's witnessed, Mason has dreams of becoming a brain surgeon one day. She is considering attending K-State, where her sister Morgan, 18, will be starting her freshman year in the fall. Her brother, Chase, 19, attends Colorado State University.

Mason says the success of Mason's Wish would not have been possible without the support of the community.

"When we first started, we never imagined $1,000, let alone $100,000," Mason said. "Mom and I don't do a lot. People are really generous. And we're excited to support both cancer research and K-State."

Fred and Nancy Wolfe with Morgan, Chase and Mason

Every gift helps, and last year 97% of the funds donated came from gifts of less than

$1,000

Undergraduate cancer research ignites K-State professor's lifelong curiosity for immunology

By Sheila Ellis-Glasper

Sherry Fleming began her career in biology washing laboratory dishes at K-State. Years later, the associate professor's office sits right next to the very lab where she got her humble start.

As a military wife and mother of two, Fleming was a nontraditional student. To earn extra money while taking classes full time, she worked in a biology lab washing dishes. She remembers "bugging" professors and students about their research, intrigued by their work and bored with washing dishes and filling pipette tip boxes.

K-State professor S. Keith Chapes, now an associate director for the Johnson Cancer Research Center, gave her a chance. They won one of the center's undergraduate Cancer Research Awards for her to do a study in his lab.

Fleming's project was to investigate the ability of macrophages, white blood cells in tissues, to kill one tumor cell but not another. This ignited a lifelong curiosity about how the immune system works.

"Getting to do the research was wonderful. I got to apply logic while having fun working," she said.

Going back to get her bachelor's degree while caring for two young children was a challenge, but Fleming made it work by involving them in her education. They helped her study with flash cards and sometimes went with her to labs and classes. She set up study hall at home, and while they worked on their homework, she worked on hers, too.

At 34 years old, Fleming graduated from K-State in 1989 with a bachelor's degree in microbiology. She received her master's degree from K-State in 1991 and her doctoral degree in immunology from the University of Colorado Health Science Center in 1998.

She completed postdoctoral studies for several years at the Walter Reed Research Institute in Washington, D.C., before returning to K-State in 2004.

Currently, her research team studies the complement system, which is a first line of defense within the immune system. They want to better understand the function of complement proteins that enhance and inhibit cell killing. Complement proteins can be good for the body by killing bacteria but may also cause damage after a heart attack.

Her research has been published in dozens of publications, and she has received funding from various resources including the National Institute of Allergy and Infectious Diseases, which awarded her a five-year, $1.79 million grant for her project, "Natural Antibodies and Tissue Injury."

Fleming often involves undergraduate students in her research.

"I was given the opportunity to do research as an undergrad, and it changed what I did with my life," Fleming said. "I want to pass that opportunity on."

Students in Fleming's lab have shown that the complement system causes more damage after hemorrhage. The ultimate goal is to understand and control complement killing of cells, allowing it to be "turned on" to kill tumor cells and "turned off" to stop tissue damage after a heart attack, she said.

"Undergraduates can come up with the craziest ideas that can actually be right," she said. "They have a different perspective."

Recently, the team developed a therapeutic peptide that decreases tissue damage after surgery. The students have even used the peptides to slow the growth of melanoma, a type of skin cancer.

Years after participating in the Cancer Research Award program as an undergraduate student, Fleming now serves as a faculty mentor for the program and participates in other undergraduate research programs as well, including the K-INBRE and Developing Scholars programs.

Our talented faculty won **$13,000,000** in national funding in 2013, some leveraging our seed grants.

$1,167,500 has been invested in undergraduate research training since 1980.

50 undergraduates a year receive research training with our annual investment of

$100,000

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