2016 | Vol. 3

explore

Research at the University of Missouri-Kansas City

A TEAM APPROACH TO TARGETING HIV

Exploring a new, potential therapy

Students at the UMKC School of Computing and Engineering get hands-on experience with robotics.

PHOTO: UNIVERSITY ARCHIVES

explore

2016 | Vol. 3

Explore is published by the UMKC Office of Research and Economic Development in collaboration with the UMKC Division of Strategic Marketing and Communications to highlight the achievements and contributions of UMKC's researchers.

Office of Research and Economic Development

LAWRENCE A. DREYFUS
Vice Chancellor

Division of Strategic Marketing and Communications

ANNE HARTUNG SPENNER
Vice Chancellor

KARA PETROVIC
DAVID MARTIN
HALLIE SPENCER
Editors

ELAINE ADAMS
SANDY BEATY
STACY DOWNS
KELLY EDWARDS
SUZANNE KING RANEY
BRIDGET KOAN
JOHN MARTELLARO
DAVID MARTIN
HALLIE SPENCER
Writers

DAVID KEETER
Design

NEIL NAKAHODO
Illustration

JANET ROGERS
DAN VIDETICH
Photographers

info.umkc.edu/research

COVER PHOTO: DAN VIDETICH PHOTOGRAPHY

PHOTO: BRANDON PARIGO

"It can be said that universities are in the business of knowledge management.

Though our primary mission is to educate our students, we accomplish this task by managing knowledge — that is, the transfer of knowledge to our students during the process of learning and the dissemination of that knowledge as they progress in their lives and careers. We also apply knowledge as a means to, hopefully, solve problems that we face as a community and a society. But what truly sets us apart from other institutions of learning, and defines us as a university, is our engagement in the pursuit and creation of knowledge through research and scholarly endeavors.

We are privileged at UMKC to have a wealth and breadth of excellent faculty and numerous academic programs and disciplines covering just about every imaginable area of scholarship. And it is through these programs and the tireless endeavors of our faculty that research emerges. Whether it is research leading to a cure for cancer, exploring new high speed computer networks that behave like neural pathways, or discovering insights into the ancient world that parallel our lives today, scholarship is a fundamental pursuit of universities, and UMKC is no exception to this rule.

One of the reasons we publish *Explore* is to celebrate the accomplishments of our researchers and scholars. Another is to increase awareness in our community and statewide of how we steward the investment you, as citizens and taxpayers of the State of Missouri, have made in UMKC. We are truly indebted to the support we receive and hope that our return on that investment is recognized, in part, as you read through this issue.

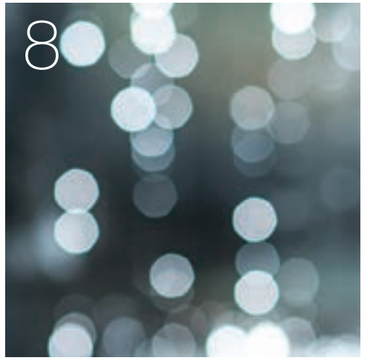
My hope is that *Explore* will inspire you look more closely at our faculty's research and the cutting-edge work they do day in and day out in their pursuit of excellence.

It is with tremendous pride that, through the stories in this issue, I present to you some of our very best and brightest researchers and scholars.

In getting to know them, I hope you experience even just a part of the joy that I have in introducing their stories to you.

Lawrence Dreyfus, Ph.D.
Vice Chancellor for Research and Economic Development

Welcome to
explore



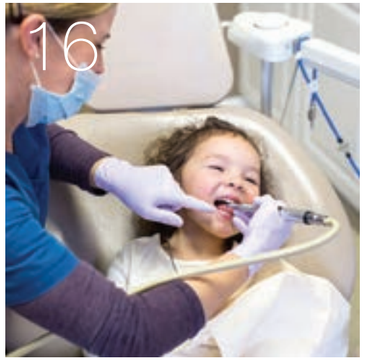


Table of Contents

Cover Story

Features

Explorations

RED 15091212

A powerful new approach

PHOTO: DAN VIDETICH PHOTOGRAPHY

Kun Cheng, Ph.D., associate professor of pharmaceutical science, stands in the lab where he and his team perform ground-breaking research in siRNA treatment for cancer.

UMKC researcher works to enlist a type of RNA in the treatment of breast cancer and liver disease.

by Elaine Adams

As Kun Cheng, Ph.D., works at devising new biotech drugs for breast cancer, he needs no reminder of how profoundly his research might change the lives of ordinary people.

Cheng's aunt was diagnosed with breast cancer just before he joined the UMKC pharmacy faculty in 2007.

"She was only 50 years old, and my uncle was desperate for any possible treatments," he says. "That is how I got to know breast cancer and decided to initiate my breast cancer research."

His aunt survived, but pancreatic cancer killed his father in 2013.

"I have gone through the shock, desperation and sadness as many others who are battling with cancer," he says. "Therefore, I have a very strong empathy for cancer patients and their family members."

Cheng, an associate professor, has recently brought the School of Pharmacy $525,000 from the American Cancer Society for breast cancer research and nearly $1.7 million to fight liver fibrosis, a precursor to the often-fatal cirrhosis of the liver.

Central to both projects is a large molecule, or macromolecule, called small interfering RNA (siRNA), which blocks the expression of certain genes — such as cancer-inducing oncogenes — by interfering with the transmission of genetic information in cells.

Cheng calls siRNA "one of the most important findings in biomedical research in the past 18 years."

"It can specifically and potently block a gene to study its function or treat a disease," he says.

The potential payoff is huge for cancer patients, who now confront the miserable, even life-threatening, side effects of traditional chemotherapy.

"Many times you have to stop treatment because the side effects are too great," Cheng says, "but when you stop treatment, the cancer cells come back."

While siRNA is far less toxic than chemo, it's of little value to patients by itself. Its large size and negative charge prevent siRNA from efficiently entering cells. And without alterations, Cheng said, it will quickly degrade in the body.

The molecule is so unstable that Cheng's team, which also includes UMKC faculty members Hari Bhat and Daniel Dim, will store siRNA at -112 degrees Fahrenheit to keep it from breaking down.

Cheng's goal is to make siRNA more effective and to deliver it more efficiently to tumors while minimizing the harm to healthy tissue.

For breast cancer, Cheng is targeting an oncogene that's active in about 30 percent of breast cancers. Previously, his team showed that blocking that gene with synthetic siRNA significantly curbed tumor growth in the laboratory and looked promising in rodents.

Now he's looking at chemical connectors that will bind siRNA with cancer cells and bring the drug deeper into breast tumors. The connectors must drop away, however, once it enters tumor cells.

"That's challenging," Cheng says.

siRNA is small as macromolecules go, and Cheng is using small connectors, which not only work better on tumors but also are more conducive to large-scale production by drug companies. If successful, the research holds promise for other malignancies influenced by the same oncogene, including prostate, ovarian and brain cancer.

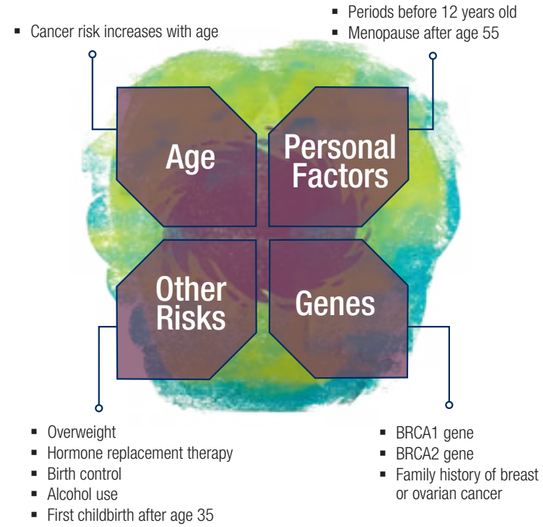
As for his other major grant work, Cheng began his liver fibrosis research before arriving at UMKC. His latest study targets fibrosis caused by alcohol abuse, which accounts for more than half the cases.

Previously, Cheng and his team proved that alcohol increases the expression of a certain gene in liver cells, and they developed siRNA that silenced that gene and reversed the buildup of a collagen seen in diseased livers.

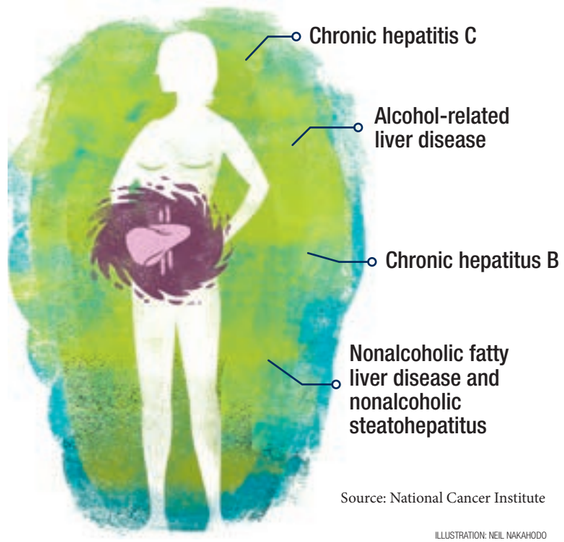
The next step is to effectively deliver the drug in patients. All fibrosis patients could benefit, whether their disease is caused by alcohol, hepatitis or some other factor, because the same target gene is at work in all.

Curious and scientific, even as a child, Cheng looks forward to how his work can bring hope to individuals and families suffering from the effects of cancer and liver fibrosis.

Risk factors for breast cancer



Common causes of liver fibrosis



Source: National Cancer Institute

ILLUSTRATION: NEIL NAKAHODO

Meet the researcher

Kun Cheng, Ph.D.
Associate professor of pharmaceutical sciences,
School of Pharmacy

RESEARCH INTERESTS: Developing targeted delivery systems for drugs that treat cancer and liver disease, primarily those involving a gene-silencing macromolecule called siRNA

JOINED UMKC: 2007

ACCOMPLISHMENT: Secured more than $2 million in grants for projects involving breast cancer and liver fibrosis research

Barbarians at the gate

"Battle between Romans and Barbarians" by the French artist Theodore Chassériau. COURTESY OF NELSON-ATKINS MUSEUM OF ART

Conquering barbarians absorbed the culture of ancient Rome, shaping the development of early medieval Europe.

by Sandy Beaty

A beautifully rendered church mosaic, a worn coin, a famous gold medallion — each bearing the images of men and women from Italy's distant past. These representations were a common part of Prof. Massimiliano Vitiello's Roman boyhood. But later, examining these same items with a scholar's eye, Vitiello considered the stories behind these familiar faces and their place in Roman history.

Over time, Vitiello focused his research on Late Antiquity and the early Middle Ages (300-800 A.D.). Since coming to UMKC as a visiting professor in 2010, he has been promoted to associate professor of ancient history and late antiquity, and has devoted most of his studies to the barbarian invasions of the Roman Empire and their impact on the classical world.

For example, an unknowing reader might assume that Rome's barbarian conquerors arrived with plans to reject and destroy Roman culture and learning.

"Typically, a conquering people would impose their social, cultural and civil standards on the vanquished," Vitiello says. "This was not the case when the Goths came to power in Italy in the late fifth century. Despite these warring invaders who periodically seized power in Rome or established new seats of government, the preservation and continuation of Roman values were left intact."

Vitiello's fascination with the bonds of Germanic and Latin/Greek culture remains strong, because the modern Western world is the direct heir of this great cultural experiment.

"I'm sure this continuity contributed to the memory of Roman history surviving in the later empire, and to the shape of society as early medieval Europe was formed," Vitiello says. "Indeed, the merger of societies and peoples in the Mediterranean world resulted in a diversity of cultures."

Using Latin and Greek sources, Vitiello is filling in the blanks and reconstructing portions of lost works. In doing so, he hopes to resolve several significant questions: What led the so-called "barbarians" to assimilate and absorb Roman culture? How did this fusion create the world of medieval Europe?

Vitiello's research is most rewarding when he recovers something that has been lost for so long. In a recent project, he was able to recreate and reconstruct details about the life and rule of an extraordinary woman, the Gothic queen Amalasuintha. It was exciting to find out how she was both positively and negatively represented by her contemporaries.

A current favorite of Vitiello's and the subject of his forthcoming publication, Amalasuintha was from a political family, a king's daughter who outlived her husband and manipulated her son during his brief rule, assuming the throne herself when he died.

"It was very interesting to see how a Germanic woman created an image that allowed her to hold political power equal to that of a Roman empress," he says. "Germanic women were not taught to be leaders. As wives of rulers in parts of the former Roman Empire they were educated to reinforce their Christian virtues, not to prepare them to rule.

"There were powerful females during the transition from the Roman Empire to the Middle Ages; but they were the power 'behind the throne,' influencing their royal husbands or affecting the culture of his court. This makes Amalasuintha all the more unusual, as she ruled in her own right."

Another of Vitiello's current subjects is Theodahad, a Gothic "philosopher king" who much preferred the study of ideas to empire building. Theodahad is emblematic of a different kind of nobleman emerging in the sixth century. In general, Gothic warriors had a very martial education, but Theodahad was bookish and thoughtful.

A deeper examination of Vitiello's work shows that, while there are not direct lines of contact, some modern leaders and would-be leaders have adopted a few of the ways of antiquity.

Then, works of art depicted rulers in both royal and religious garb. Now, politicians pose for pictures with the pope or the Dalai Lama. Then, lights, lamps and eyes were images of power, used as a metaphor for imperial rule. Now, we fear being scrutinized by our government, whose eyes and ears seem to be everywhere. Then, courtiers of Roman rulers wrote letters criticizing other hangers-on or even, on occasion, their own leaders. Now, political insiders get lucrative book contracts to spill secrets about the private lives of their superiors or other staffers.

Hawks or doves? Then as now, image is everything.

Meet the researcher

PHOTO: DAN VIDETICH PHOTOGRAPHY

Massimiliano Vitiello, Ph.D.
Associate Professor of ancient history and late antiquity,
College of Arts and Sciences

RESEARCH INTERESTS: Roman historiography, history of texts (quellenforschung), social and economic history, epigraphy and numismatics

JOINED UMKC: 2010

ACCOMPLISHMENTS: Trustees' Faculty Scholar Award; twice awarded the Alexander von Humboldt scholarship in Germany; invited to present research at international conferences in Brazil, Scotland, Germany and France

New frontiers in vision research

Early signs of Alzheimer's disease and other neurodegenerative diseases may be found in the eye.

by Kelly Edwards

Peter Koulen, Ph.D., director of basic research at the University of Missouri-Kansas City's Vision Research Center, likens the gradual progression of eye disease to wearing a pair of old shoes. You don't realize just how bad they have become until you put on a new pair. Just as shoes wear out over time, many of the human body's organ systems and tissues similarly begin to decline with age.

Determining the early stages of eye disease is obviously much more complex than slipping on a new pair of shoes and requires expert physicians. Treating and curing eye disease is even more difficult and prompts the need for continued research as effective treatments for many diseases affecting vision are still lacking. Koulen and his team are exploring ways to slow degeneration and the eventual death of cells in the eye and brain.

"We're trying to help individuals age well," Koulen says.

Since coming to the School of Medicine in 2009 as the Felix and Carmen Sabates Missouri Endowed Chair in Vision Research, much of Koulen's research has focused on therapies for glaucoma, macular degeneration and diabetic retinopathy, three major eye diseases that together affect nearly one-quarter of the population. The National Eye Institute estimates 38 million Americans age 40 and older experience blindness, declining vision or age-related eye diseases. That number is predicted to rocket to 50 million by 2020, driving home the urgent need for new ideas and therapies for vision-related diseases that currently have no known cures.

Clinicians and researchers at UMKC's Department of Ophthalmology have long been recognized as trailblazers in developing and adapting clinical diagnostics and therapies for patients. Much of Koulen's work focuses on ways to help the body's own self-defense mechanisms slow the deterioration and death of retina cells which lead to failing vision. It also focuses on improving diagnostic processes that allow ophthalmologists to intervene earlier to impede the progression of these diseases.

A new imaging system recently implemented in the eye clinics at UMKC, for example, has proven successful in detecting early stages of diabetic retinopathy before an endocrinologist or ophthalmologist would typically suspect a patient of having the ailment.

"That allows the patient to be very vigilant and very conscientious about their disease and work together with their clinician in getting early treatment," he says. "But all these things require research. They require new thinking, and they often don't come cheap. When you're coming up with new technology, it involves a lot of groundwork."

For Koulen, that meant developing a still-growing database of information to define the baseline level of what healthy eye tissues look like and those often subtle deviations which might be an early indicator of a particular disease. His latest work is a perfect example.

When researchers study how different diseases affect the retina, a light-sensitive eye tissue that is actually part of the body's central nervous system, they are in essence studying the brain. Using that rationale, studies at the Vision Research Center have recently branched out to benefit other fields of medicine. It turns out, those diseases that have been Koulen's primary targets for therapy development also have many similarities to other incurable and debilitating neurodegenerative diseases such as Alzheimer's, Parkinson's and ALS.

Using the information collected from patients and working with local neurologists for almost two years, the UMKC researchers recognized that particular abnormalities detected in the retina during a detailed eye exam can point to the onset of Alzheimer's, another slow-progressing disease that can be difficult to diagnose.

"We were able to pick up that these patients very likely had the neurological disorder before the neurologist was able to diagnose the very earliest forms of the disease," Koulen says. "The nice thing about conducting the diagnostics in the clinic is that they're non-invasive. You don't have to draw blood. You don't need anesthesia. It's basically a very complicated eye exam, but it's still an eye exam."

The discovery earned Koulen a FastTrack Award from the University of Missouri System Office of Research and Economic Development to accelerate his research and the development of the diagnostic tools necessary for physicians to pinpoint the disease.

Koulen says turning such discoveries into useful clinical tools was the primary reason for bringing his research program to UMKC seven years ago. Before coming to Kansas City, he served as director of the North Texas Eye Research Institute at the University of North Texas. Itching to add clinical and translational elements, Koulen said UMKC provided the necessary setting, and since then his research program has grown to a group of eight Ph.D. researchers, graduate students and technicians with plans to expand further, while continuing to work closely with clinical researchers and physicians.

"We have a very active clinical research team here," he says. "Kansas City is not just a place where great clinical therapy is being tested and implemented, it's also where the basic science that underlies those therapies can originate."

Meet the researcher

Peter Koulen, Ph.D.

Director of Basic Research, UMKC Vision Research Center; Professor and Felix and Carmen Sabates Missouri Endowed Chair in Vision Research, Department of Ophthalmology, School of Medicine; Professor, Department of Basic Medical Science, School of Medicine

RESEARCH INTERESTS: Basic research and therapy development for chronic diseases of the eye and brain including macular degeneration, diabetic retinopathy, glaucoma, Alzheimer's disease and stroke

JOINED UMKC: 2009

ACCOMPLISHMENT: Received a FastTrack award from the University of Missouri System Office of Research and Economic Development to accelerate development of tools to diagnose Alzheimer's disease

PHOTO: DAN VIDETICH PHOTOGRAPHY

A team approach to targeting HIV

UMKC biologists match bench science with computer power to discover a potential new therapy for treating HIV.

Around 40 million people worldwide live with HIV. The Centers for Disease Control estimates that 50,000 people in the U.S. are newly infected with HIV each year. UMKC Associate Professor of Biological Sciences, Thomas Menees, Ph.D., and Professor of Biological Sciences, Gerald Wyckoff, Ph.D., are trying to find out how to stop the virus in its tracks.

by David Martin

One day last spring, Thomas Menees helped a colleague by presenting, on short notice, at the weekly School of Biological Sciences seminar series.

Menees is a molecular biologist who studies elements crucial to the propagation of retroviruses. HIV, the virus that causes AIDS, is a classic example of a retrovirus. Upon cellular infection, these viruses convert their viral RNA into DNA and then insert this newly copied molecule into the host cell's DNA. As long as the cell is alive, it is now a source of new virus. HIV's ability to hijack genetic material and use it to replicate is one of the reasons it eludes a cure.

At the seminar, Menees explained his efforts to better understand the role a particular enzyme plays in the lifecycle of retroviruses. As he spoke, he noticed Gerald Wyckoff, an evolutionary biologist in the School of Biological Sciences, seemed to be paying especially close attention.

Wyckoff was intrigued, and as he continued to listen, he saw the potential for collaboration.

What Wyckoff brings to the partnership is a powerful computational discovery tool, developed during his research on the evolution of gene sequences.

"Just out of necessity, when you are looking at large numbers of genes, you have to have a way of organizing them," he says. "Early on, I was building simulations and tools that would allow me to simultaneously look at hundreds of genes from an evolutionary perspective."

Together, the scientists are using traditional bench science and computer programming to discover a potential new therapy for treating HIV. The target for the new therapy is an enzyme Menees has studied for 20 years. In the lab, Menees looks for chemical compounds that can deactivate the enzyme, rendering

Thomas Menees, Ph.D., (left) and Gerald Wyckoff, Ph.D., (right) discuss data points from a recent screening test.

PHOTO: DAN VIDETICH PHOTOGRAPHY

retroviruses inactive. Wyckoff runs the lead drug candidates through his software to find real and theoretical compounds with similar characteristics.

Using a conventional approach, Menees has screened several thousand compounds over a period of two years. Wyckoff's virtual system can screen millions in a short time.

"You always need to prove this stuff at the bench," Wyckoff says. "But I can do a lot of stuff in silico — computationally — that we really could have only dreamed about 20 years ago."

Menees and Wyckoff are not the only ones excited by what they might be able to accomplish working together. In 2015, they received a grant from the University of Missouri System Office of Research and Economic Development designed to "fast track" research with commercial potential.

The struggle to find a vaccine or cure is partly a function of HIV's unreliable replication system. Researchers talk about the virus being "sloppy" when it converts its RNA into DNA in a host cell. "It makes a mistake almost every single time it copies its genome," Menees says.

For a virus, sloppiness is virtue. HIV turns its knack into making defective copies of itself into an advantage.

"In the early stages of an infection, you mount a strong immune response to the virus," Menees says. "But it's always behind, because the virus is always undergoing changes, and the changed forms are the ones that end up replicating the most, because they're not being inhibited by our immune response. It's always staying ahead of us."

The virus' ability to outrun the body's immune response is one of the reasons why an individual infected with HIV frequently needs to change drug regimens. Many HIV patients take a drug cocktail to avoid creating strains of the virus immune to single drugs.

HIV's slippery nature has led Menees to focus on the way humans react to it. Viruses, he notes, depend on their host cells for many basic functions.

"Our idea was to find some novel type of host dependency — something someone hadn't described before — and figure out how that works and how broadly it's distributed among this class of viruses," he says.

Menees uses lowly baker's yeast in his research. The organism is popular with scientists because many of the processes that drive the biology of a baker's yeast cell are the same processes that drive a human cell. Its genome is also easy to manipulate — another plus.

Using yeast, Menees studies the cell material important for the propagation of retroviruslike elements. He is particularly interested in Dbr1, a debranching enzyme involved in RNA processing.

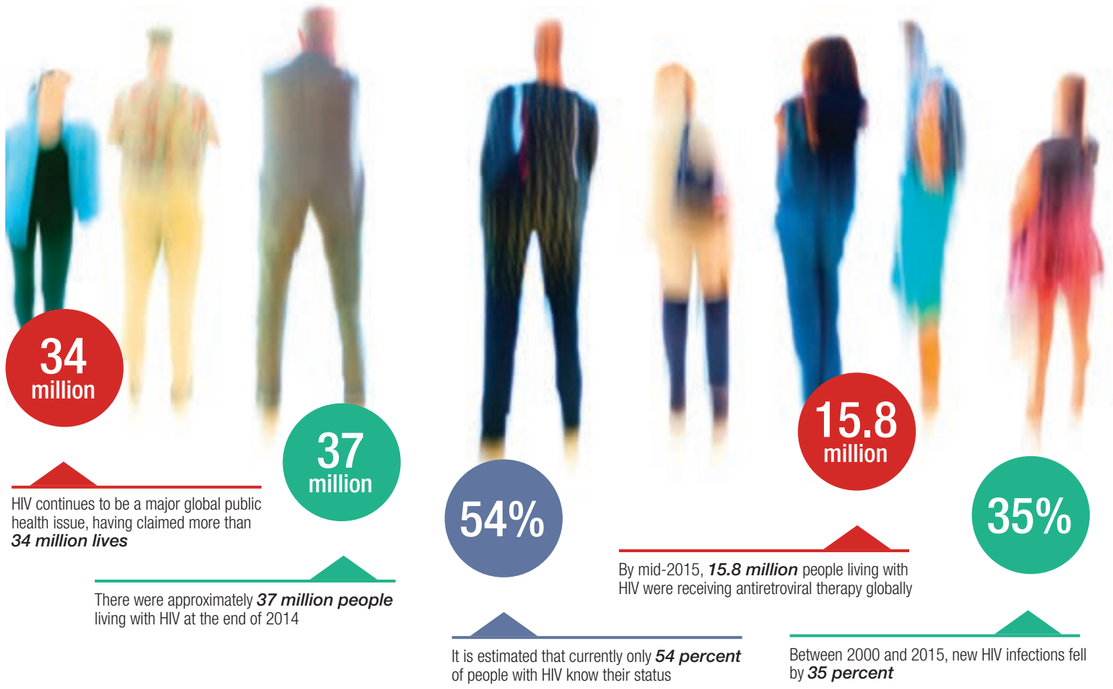
In 2004, Menees and a co-author published a paper in *Science* suggesting that Dbr1 played a previously undescribed role in HIV replication.

The idea met with resistance and continues to remain controversial. Menees, however, is confident the discovery is real. He says he's spent the past three years looking directly at the question of whether the structure described in the *Science* paper exists.

"The data's beautiful," he says.

Scientists may not agree on the particulars, but it's accepted that Dbr1 plays a role in reverse transcription, the process by which a retrovirus commandeers the DNA of a host cell. A group of existing HIV drugs target the reverse transcription step. But almost all of them target the HIV reverse transcriptase enzyme, either directly or by giving it bogus material to use.

"The problem is, they work very well until they don't, and the reason they don't is because of drug resistance," Menees says.



Menees and other researchers are hopeful about Dbr1 because it's a human enzyme and, therefore, a more stable target than the sloppily mutating virus itself.

"Our enzymes are nowhere near as error-prone," Menees says. "We could never have the error rate of HIV or we'd never get from a single cell up to a developed adult or child."

Wyckoff agrees: "We're pretty static. HIV? Not so much."

Every few months, Menees travels to Stanford University to look for compounds that inhibit Dbr1.

At Stanford, Menees uses high-throughput screening technology to analyze thousands of small molecules at the same time. The cells are genetically engineered to produce a simple readout under a microscope: bright green fluorescent spots indicate a positive for inhibition of Dbr1.

When Menees returns, Wyckoff runs the good leads through three different software programs. Wyckoff says his computational methods tease out a "fine-grain analysis" of the compounds that look like likely inhibitors. In drug development, this step is known as "hit expansion," a process of searching for compounds with similar structures.

Wyckoff's tools allow the researchers to expand their search into a theoretical realm.

"If all you can do at the bench is test the stuff you've got, you'll never see the stuff that hasn't been created," Wyckoff says. "The ability to search through compounds that are not immediately available to you means you can spend your money a lot more effectively."

If the compound looks promising but doesn't exist, Menees and Wyckoff work with a chemist to synthesize it.

To date, the researchers have identified a dozen compounds that merit further study. Menees says he's being "very picky."

"The best compounds are still in front of us," he says.

Menees and Wyckoff are focused on the practical aspects of their work. If they can identify a compound that inhibits Dbr1 in a living cell, they plan to pursue intellectual property development through invention disclosure and perhaps patent application, if appropriate.

As it stands, only one drug on the market targets the human response to the HIV virus, the path Menees and Wyckoff are taking in their research. Sold by Pfizer under the brand name Selzentry, the drug, maraviroc, blocks an important receptor.

HIV drugs constitute a $14 billion market, which Menees says reflects the staggering number of people with HIV as well as the limitations of existing drug therapies.

"We need to have ways to treat people so they can live full, productive lives and not constantly have T-cells crashing and having to switch therapies," Menees says.

Unraveling the mysteries of Dbr1 may open doors beyond HIV. Wyckoff sees potential for treating other retroviral infections, including those that affect other species, such as the feline leukemia virus, which causes cancer and other health problems in cats.

The scientists, who have taken courses in entrepreneurship through the Ewing Marion Kauffman Foundation, do not want to limit the possibilities of a collaboration born from the humble beginnings of a hastily arranged seminar.

As Wyckoff says, "You have to follow your nose, right?"

THE DRUG DEVELOPMENT PROCESS

Step 1: Discovery and development

Once researchers identify a promising compound for development, they conduct experiments to gather information on its potential benefits, side effects, interactions with other drugs and other aspects.

Step 2: Preclinical research

Before testing a drug in people, researchers must find out whether it has the potential to cause serious harm. Typically, both in vitro (in the lab) and in vivo (in a living organism) tests are performed.

Step 3: Clinical research

Clinical research refers to studies, or trials, that are done in people.

Step 4: FDA review

The FDA review team thoroughly examines all submitted data on the drug and makes a decision to approve or not to approve it.

Step 5: FDA post-market safety and monitoring

FDA reviews reports of problems and can decide to add cautions to the dosage or usage information, as well as other measures for more serious issues.

Source: U.S. Food and Drug Administration

Meet the researchers

Thomas Menees, Ph.D.

Associate professor of biology, School of Biological Sciences

RESEARCH INTEREST: Understanding how eukaryotic cells support the propagation of retroviruslike elements, a group that includes pathogens like HIV-1

JOINED UMKC: 1995

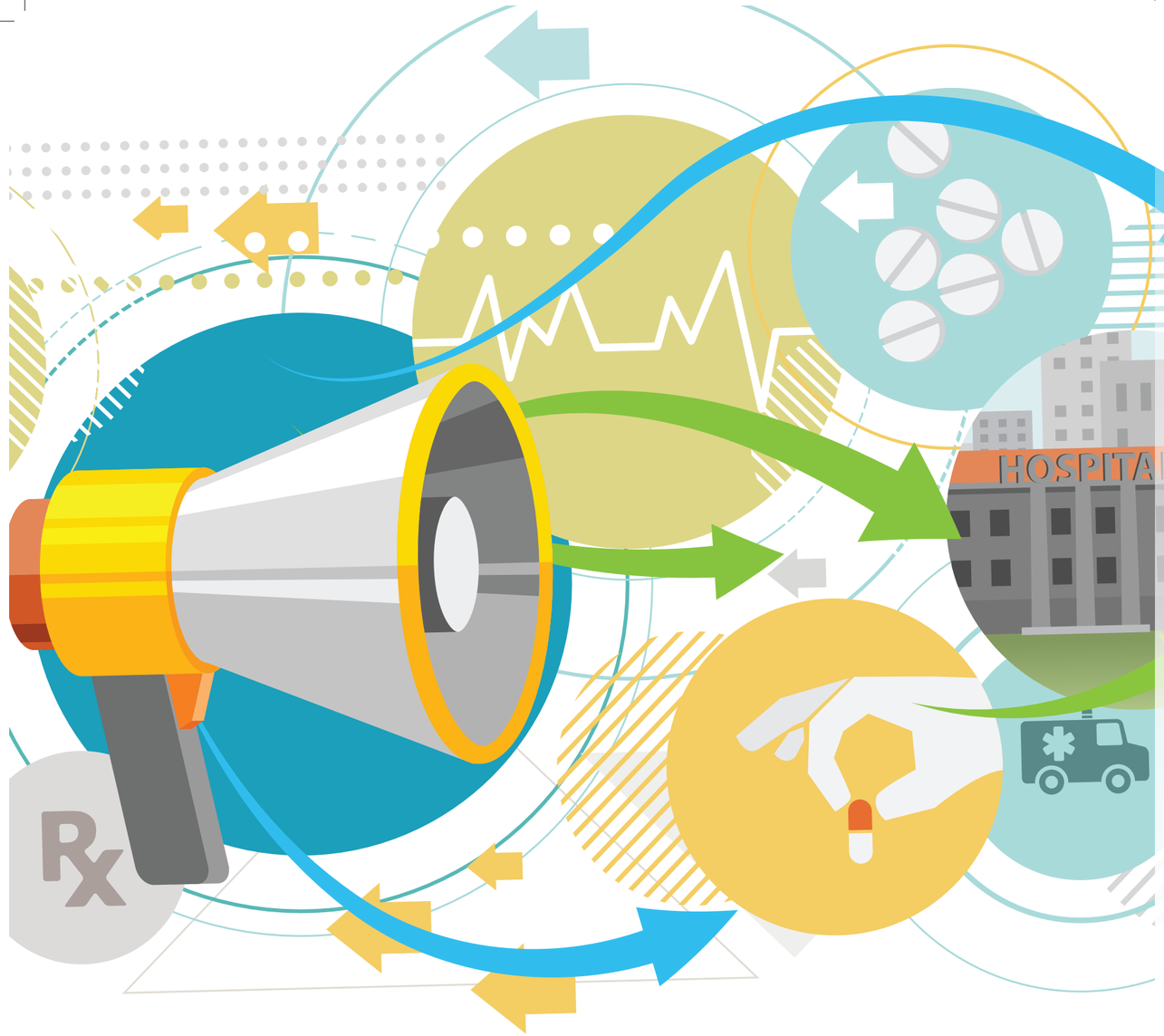
Gerald Wyckoff, Ph.D.

Professor of biology, School of Biological Sciences

RESEARCH INTEREST: Creating a relational database of genomic sequences and associated information, including expression, divergence, protein function and positional information

JOINED UMKC: 2009

ACCOMPLISHMENT: Received a FastTrack award from the University of Missouri System Office of Research and Economic Development to develop potential new HIV therapies



High-impact HIV prevention

School of Nursing and Health Studies receives $7 million grant to create resource center for HIV prevention.

by Stacy Downs

When the University of Missouri-Kansas City School of Nursing and Health Studies won a $7 million grant — the largest in the school's history — it was charged with a challenging task: build a national HIV-prevention resource center.

Laurie Krom and Jacki Witt, co-directors of the five-year award from the Centers for Disease Control and Prevention, are accomplishing the mission.

"It means a lot of relationship building," Krom says. "We are bringing together competing organizations, but it is working. Everyone is doing what they're doing for the same reasons and the same mission in preventing HIV."

In 2014, the CDC reported 44,073 new HIV diagnoses in the U.S. The grant of $1.4 million annually established the National Capacity Building Assistance Provider Network Resource Center at the School of Nursing and Health Studies. That title is more than a mouthful, so one of the tasks was creating a brand. Krom, Witt and a staff of 18 formed CPN, or Capacity Building Assistance Provider Network.

Together, they work with more than 20 national and regional health departments and organizations from coast to coast to help the nation's HIV prevention workforce use best practices in planning, implementing and evaluating high-impact HIV prevention programs.

"We're introducing UMKC to a lot of people across the country," Witt says. "It's given us an opportunity to use our fields of expertise."

The UMKC School of Nursing and Health Studies has already established national coordinating expertise in the areas of behavioral and reproductive health programs; that expertise was a significant factor in gaining the new national headquarters for Kansas City.

"We're very excited because this was such a competitive grant process," Krom says. "UMKC stands out because of our expertise in national network building, instructional technology and strategic marketing. We are also uniquely located on an interprofessional life sciences research campus."

UMKC's Health Sciences Campus at Hospital Hill includes the Schools of Dentistry, Medicine, Nursing and Health Studies, and Pharmacy, and each have HIV-related research. UMKC is nationally recognized for its HIV prevention research and strategies in African-American churches.

The grant proposal was based on the model of the Collaborative for Excellence in Behavioral Health Research and Practice's Addiction Technology Transfer Center (ATTC) National Office, which mobilizes the power of the ATTC Network to efficiently and effectively promote the adoption and implementation of evidence-based addiction treatment practices.

"The new resource center brings together all of the strengths of our school," Witt says. "We have assembled an interprofessional team of researchers, clinicians, advocates, educators and administrators who will offer a fresh perspective to building the capacity of the U.S. HIV prevention workforce."

Meet the researchers

LEFT TO RIGHT: WITT AND KROM; PHOTO: JANET ROGERS

Laurie Krom, M.S.

Co-director of CPN: Building the Capacity of the Nation's HIV Prevention Workforce and program director of Collaborative for Excellence in Behavioral Health Research and Practice, School of Nursing and Health Studies

RESEARCH INTEREST: Substance abuse prevention training

JOINED UMKC: 2004

Jackie Witt, J.D., M.S.N

Co-director of CPN: Building the Capacity of the Nation's HIV Prevention Workforce and project director of the National Clinical Training Center for Family Planning, clinical associate professor, School of Nursing and Health Studies

RESEARCH INTERESTS: Substance abuse prevention training

JOINED UMKC: 1994

ACCOMPLISHMENT: Co-directors of $7 million award from the Centers for Disease Control and Prevention to establish a national HIV-prevention resource center

Expanding the oral health care workforce

Grant will allow researchers to study the effect of allowing dental hygienists to provide basic care.

by Suzanne King Raney

When Melanie Simmer-Beck, a UMKC School of Dentistry professor, began working to bring better oral health care to children in Kansas, she was often surprised at the level of tooth decay she and her colleagues saw in their young patients.

The children who came to in-school clinics in several Olathe, Kan., public schools often were sitting in a dental chair for the first time. Many times the state of their teeth was shocking. But surprisingly, the kids barely seemed to notice the pain they must have been feeling.

"They were so used to it, they thought it was normal," she says.

In light of ongoing provider shortages — especially for low-income patients without resources to pay for care — some states, including Kansas, are trying to provide care to more patients by allowing dental hygienists to go into communities and provide preventive dental care without direct dentist oversight. More complicated cases are referred to dentists, but routine cleanings and care can be taken directly to the communities that need it most.

Simmer-Beck, a dental hygienist by training, has been on the leading edge of an effort to study the effectiveness of expanding the dental health workforce — allowing registered dental hygienists to deliver patient services without the direct supervision of a dentist.

Now, Simmer-Beck and Pat Kelly, a UMKC School of Nursing and Health Studies professor, are working together on a grant from the National Institutes of Health, specifically the National Institute for Dental and Craniofacial Research (NIDCR), to look further into the effectiveness of this practice.

"We're just hoping we can do a good analysis and not have biased results. But in my heart of hearts I'm hoping to show that this legislation — expanding the dental health workforce — would make a difference," Kelly says.

The five-year grant, worth up to $4.38 million, will compare dental models in Kansas, where dental hygienists are allowed direct patient access, to those in Missouri, where dental hygienists must provide dental care in the presence of a dentist.

"Our hypothesis is that the model in Kansas will provide as good, if not better, care as the traditional model, and that it will be more cost-effective," Simmer-Beck says.

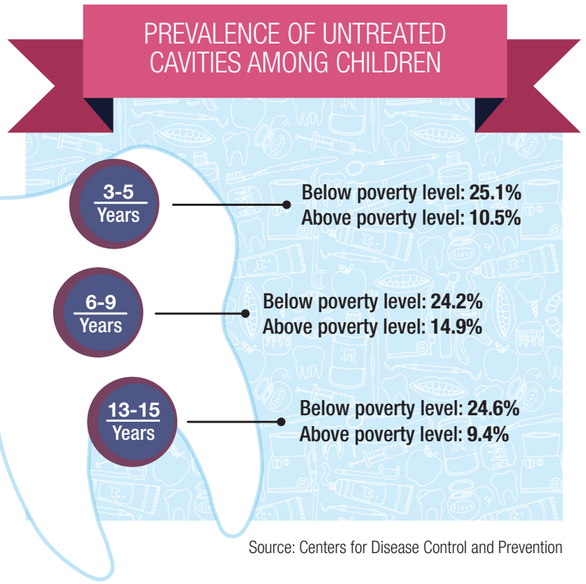
Children from certain racial and ethnic groups or from families with low levels of education and income are far more likely than other children to develop oral diseases, including tooth decay. Last year, the National Center for Health Statistics reported that Hispanic and Latino children and African-American children are about twice as likely as white children to have untreated tooth decay in primary teeth. One of the main reasons for the disparity is that there simply aren't enough dentists to provide care.

Simmer-Beck's Ph.D. educational program, supported by a NIDCR training grant (T32), centered around data collected through the public school clinics in Olathe, Kan., which the School of Dentistry organized and operated under a grant from the REACH Healthcare Foundation. Based on data collected at those clinics, Simmer-Beck found that getting children to the dentist more often, even if care was provided only by a dental hygienist, improved the oral health status of low-income children who would not otherwise have received care.

Simmer-Beck and Kelly hope the NIH study, done in collaboration with the Kansas Bureau of Oral Health School Sealant Program, will help add to the research that supports additional programs like the one in Kansas that allows hygienists to provide more care.

"This project will identify cost-effective, evidence-based strategies that improve access to dental providers in rural and urban underserved communities and ultimately reduce the number of children in Kansas who experience pain and suffering from oral health problems that are largely preventable," Simmer-Beck says.

The NIH grant funding the study is part of 10 research cooperative agreements awarded nationally, aimed at eliminating inequities in access to care and improving the oral health of children. They support the Multidisciplinary and Collaborative Research Consortium to Reduce Oral Health Disparities in Children, a new initiative of NIDCR.



Source: Centers for Disease Control and Prevention

Meet the researchers

LEFT TO RIGHT: KELLY AND SIMMER-BECK; PHOTO: JANET ROGERS

Patricia J. Kelly, Ph.D., M.P.H., APRN
Professor, School of Nursing and Health Studies

RESEARCH INTERESTS: Public health disparities in vulnerable populations

JOINED UMKC: 2004

Melanie Simmer-Beck, Ph.D., RDH
Professor and Admission Enhancement Program Director, Department of Dental Public Health and Behavioral Science, School of Dentistry

RESEARCH INTERESTS: Access to oral health care, oral health disparities, workforce models, quality assessment and ergonomics

JOINED UMKC: 2004

ACCOMPLISHMENT: Co-investigators on a National Institutes of Health grant, potentially totaling $4.38 million, to study dental hygienist care of children in Kansas and Missouri

Stress testing networks

UMKC researcher works to minimize the threat natural disasters and other calamities pose to computer networks.

by John Martellaro

UMKC researcher Deep Medhi is working at the leading edge of an increasingly critical field: understanding how electronic communication networks operate — and fail — under conditions of extreme stress.

His primary goal: creating computer, cellular and other network infrastructure that can survive, or be quickly restored, after a major natural disaster such as a tornado or earthquake.

The project is not about making sure you can post a selfie while sitting in the rubble. In the 21st century, police, fire, medical, emergency management and transportation management teams all depend on networked systems. If a natural disaster obliterates street signs and familiar landmarks such as buildings and trees, network connectivity is vital for emergency responders to know where they are and where they are going.

At the same time, a natural disaster sends people flying to their smartphones, flooding all platforms as they try to connect with friends and relatives, clogging an already severely taxed system. In the days that follow, insurance and financial systems become critical to recovery and rebuilding.

"As a researcher, I sit at the crossroads between science and engineering," Medhi says. "From a science perspective, I want to understand if the current computer networks work well under a number of situations, and what could deter them from working well. As an engineering researcher, I want to see if we can devise new methods or solutions to improve the current situation. What can we do to make computer networks more resilient or self-healing if a failure event occurs?"

Step one is figuring out how to measure the causes and impact of network failures, which will make it possible to construct mathematical models and algorithms for testing different approaches.

Such modeling is critical to developing solutions. Researchers can't wait for another tornado to test each theoretical approach. Modeling also allows Medhi to factor cost-benefit analysis into his calculations. He's looking for real-world solutions and recognizes that a cost-prohibitive solution is no solution at all.

One promising approach is to prioritize network traffic based on the source — giving first responders priority access during emergencies.

"There was an earthquake in Los Angeles causing physical damage to the communication network. People found out about the earthquake from CNN and called their friends and families to find out if they were okay. That created a huge surge in traffic to L.A.," Medhi says. "My work looks at resilient network design. First, redundancy should be built in a cost-effective manner with a goal of providing limited services, especially for prioritized users under duress. Second, we look at ways to create alternate routing options so some traffic can still go through under severe situations."

Through modeling, Medhi is also looking for ways to prevent or inhibit "butterfly effects" — local failures that spread repercussions through far-flung systems. A 2008 *Boston Globe* article described the "butterfly effect" as "the concept that small events can have large, widespread consequences." The name stems from former MIT meteorologist Edward Lorenz's suggestion that "a massive storm might have its roots in the faraway flapping of a tiny butterfly's wings."

"Consider an undersea fiber optic cable cut somewhere in the Mediterranean," Medhi says. "This can potentially affect all call center traffic between workers in India and customers in the U.S."

He says a lot of people aren't even aware that such "butterfly effects" are possible.

"The primary limitation of most current approaches is that failures are considered very local," he says.

Medhi's research seeks to identify what new approaches are needed to contain such problems so that the failure does not have a cascading effect on parts of networks that are far away from the failure.

Now, as vast quantities of data are moving to "the cloud," Medhi is examining vulnerabilities there.

"Most recently I've focused on networks behind cloud computing. For massive cloud services, we rely on complex data center networks," he says. "How do we evaluate, design and evolve data center networks for dynamic traffic and dynamic service requirements? And we need to understand where and how big data fits in the design and analysis of large data center networks."

Medhi cautions that people should look for slow but steady progress, rather than dramatic breakthroughs, in this type of research.

He has spent more than a quarter of a century trying to understand failures, initially single isolated failures, and then interdependent failures in computer communication networks.

One of the important underlying factors that impacts recovery from a failure is the routing and re-rerouting property of a computer network.

A science problem in computer networks that has intrigued him for many years is whether multipath routing provides substantial benefits. The conventional wisdom in the field has long been that multipath routing is better than single-path routing. That is, if there are multiple ways to go between any two points in a network, it would be better than just one path between the same two points.

Intuitively, that makes sense. But the question Medhi addressed with his research collaborators is: When every pair of points (or nodes or routers) in a network has traffic between them, does it make sense for every pair to resort to multipath routing when they are all contending for the same resources (capacity) in the network at the same time? Medhi recently established a very counterintuitive theoretical result for a range of goals, and he quantified the impact for a number of scenarios. In general, as the network size grows, the benefits of multipath routing diminish, and the performance is nearly the same as if everyone were to use single-path routing. This matters in reducing the routing table size at routers without compromising on efficiency for sending traffic such as web pages.

Lately, Medhi has been fascinated by the problem of quantifying and improving the quality of experience for watching a video on the Internet. His research team has developed tools to measure and quantify what could potentially make the quality of experience vary for different people watching from different locations. His team has also developed an algorithm to improve quality of experience of watching movies over the Internet that has been measured to perform better than the method used by Netflix.

"Proposing a new scheme or algorithm or model is not sufficient; it must be backed by a strong set of studies appropriate for the problem. In the process, it is also important to point out the strengths and weaknesses of a method," Medhi says. "The vision is important — where we want to go — but innovation requires that we take incremental steps toward the vision."

Meet the researcher

PHOTO: DAN VIDETICH PHOTOGRAPHY

Deep Medhi, Ph.D.

Curators' Professor of Computer Science Electrical Engineering, School of Computing and Engineering

RESEARCH INTERESTS: Resilient computer networks, reconfigurable networks, network routing, video quality of service

JOINED UMKC: 1989

ACCOMPLISHMENTS: Grants totaling more than $6.4 million from the National Science Foundation, DARPA and other agencies; N.T. Vetch Award (2012); Chancellor's Award for Excellence in Graduate Mentoring (2012); Curators' Professorship (2011); Interdisciplinary Doctoral Student Council's Outstanding Doctoral Faculty Award (2009)

Using data to prevent crime

PHOTO: THE KANSAS CITY STAR

Criminal justice professors help police synthesize intelligence.

by Bridget Koan

When thinking of research, criminology and criminal justice may not be fields that normally come to mind. But for two UMKC faculty members, analyzing crime data is research that can save lives.

From 2010 through 2013, Kansas City ranked among the worst of the 50 largest cities in the U.S. for homicides, averaging more than 100 per year — a rate of 22 per 100,000 residents. This was two to four times greater than the national average.

Wanting to reduce violent crime, Kansas City leaders looked at programs in cities of similar size. They found positive results with focused deterrence programs in Boston and Cincinnati and liked what they learned, so they moved forward with a plan to implement a focused deterrence program in Kansas City.

With local agencies on board, only one more piece was needed — the researchers. Jackson County Prosecutor and UMKC Alumna Jean Peters Baker looked to UMKC, the only urban-based research university in the region. She approached Kenneth Novak, chair of the UMKC Criminal Justice and Criminology Department, with the idea.

"She was motivated," Novak says. "So was the police chief and the mayor. The research project chose us."

Not long after, Andrew Fox joined the UMKC Department of Criminal Justice and Criminology as a professor. He had experience with social network analysis — a research tool that is important for implementing focused deterrence. Novak and Fox became the researchers behind the Kansas City No Violence Alliance (KC NoVA).

The program is a multi-agency, collaborative effort to reduce gun-related violence, particularly homicides and aggravated assaults, in Kansas City's urban core. The premise involves enforcement, social services and community leaders. They communicate messages of violence prevention to people at the highest risk of committing or being a victim of gun violence.

In the early stages of KC NoVA, Novak and Fox helped police use their own official data to track reported incidents of homicide and aggravated assaults with a gun. That data is used as they conduct audits of violent criminals, map social network connections and use those connections to encourage criminals to police themselves. Law enforcement can intervene and offer social service referrals.

Most of Kansas City's violent crimes are not random, Novak says. Their research identifies potential groups using street-level intelligence and analysis. Police crime analysts, faculty and students analyze data to find those most likely to commit violent crimes.

Law enforcement officials can communicate with current offenders, letting them know future violence would have serious consequences. At the same time, social service agencies provide resource opportunities to avoid violence. This gives potential offenders good reasons to cooperate with the efforts to reduce violent crime.

Novak says this is a "teach a man to fish" concept. Novak and Fox don't make decisions; instead, they serve as advisors. But they have a seat at the table and make real-time recommendations as they quickly share data with KCPD. Open communication, trust and transparency have been key to the success.

"It's like research without a net at times," Novak says. "We can take what we know and learn to help guide policies and approaches. The research evidence is used to inform and decide what is done."

For example, Fox says different strategies are used for identifying high-risk offenders. The strategies are chosen based on data collected. Novak and Fox call it "action research." They already know the level of violence is high in Kansas City. Fox says many people at high risk of committing a crime carry guns for protection. He says the goal is to develop a system to stop retaliation.

The first full year of KC NoVA implementation, 2014, saw the lowest homicide rate in KC since 1972. But 2015 saw another rise in violent crime.

"There's so much more that can be done to address the violence in Kansas City," Fox says. "This is one strategy that has worked."

Fox also trained police intelligence officers to do their own analysis and mapping. They help KCPD crime analysts conduct social network analysis in order to identify violent offender groups.

An added benefit to the KC NoVA project has been training of new professionals to work in the system. Over the past three years, UMKC students have helped with different aspects of KC NoVA, including implementation and evaluation.

"Students have been helpful," Novak says. "The good ones are getting hired by agencies participating in KC NoVA."

He says it has been great real-world exposure for students.

"Being involved in research as a student was of tremendous benefit to me both academically and professionally," says Nisha Stephen, information and data analyst for the Jackson County Prosecutor's Office. "In my current job, I continue to access skills that I learned with Dr. Fox when it comes to working with data sets, identifying issues with the data and conducting analyses."

The research being conducted by Novak and Fox is unique, but not unheard of. Traditionally, criminal justice agencies do not have a lot of internal research and development, Novak says. Therefore, UMKC research is in a position to provide an important role in addressing and solving important problems, such as violence in Kansas City.

"The research is real," Novak says. "But it's messy. There's no clear beginning, middle and end."

And the work is ongoing.

"We want to help them do the best possible job," Fox says.

Meet the researchers

LEFT TO RIGHT: FOX AND NOVAK; PHOTO: DAN VIDETICH PHOTOGRAPHY

Andrew Fox, Ph.D.

Former assistant professor of criminal justice and criminology, College of Arts and Sciences

RESEARCH INTERESTS: Crime prevention, street gangs, communities and social network analysis

JOINED UMKC: 2012 (accepted a similar position at CSU Fresno in Fall 2016)

Ken Novak, Ph.D.

Professor of criminal justice and criminology, College of Arts and Sciences

RESEARCH INTERESTS: Policing in America and police behavior

JOINED UMKC: 1999

ACCOMPLISHMENT: Participation in a multi-agency effort to reduce violent crime in Kansas City, Mo.

spotlight

There is a lot of talk about “big data” and its applications. For Peter Eaton and the rest of the Center for Economic Information staff, they use it to effect positive change in the lives of families in Kansas City.

What does the center do?

The Center for Economic Information uses geographic information systems tools and surveys housing conditions in the metro area on a regular basis. That information allows CEI to associate housing conditions with numerous other indicators, as well as create a baseline to evaluate the impact of policy changes on neighborhoods.

What projects do you have right now?

We are currently working with Children’s Mercy and the U.S. Department of Housing and Urban Development to identify factors contributing to childhood asthma, lead poisoning and injury. One theory we are testing is whether homes that successfully keep airborne lung irritants outside result in a reduced incidence of asthma. For analysis, we are associating our housing survey results with address-level medical records from Children’s Mercy and other controls such as proximity to roads, demographic variables and environmental data.

What impact could this study have?

If there is public health money available, where should we concentrate it? In this case, we may find that it would be wise to invest it in sealing a house better: fixing roofs, windows and foundations to keep mold out. In addition, we might be able to save the health system money if we discover that our cost-effective exterior method of surveying is as good a predictor of childhood asthma as the interior study of homes that Children’s Mercy is currently doing. Eventually, if our method is a good predictor of childhood asthma, we may expand the method to adult cases.

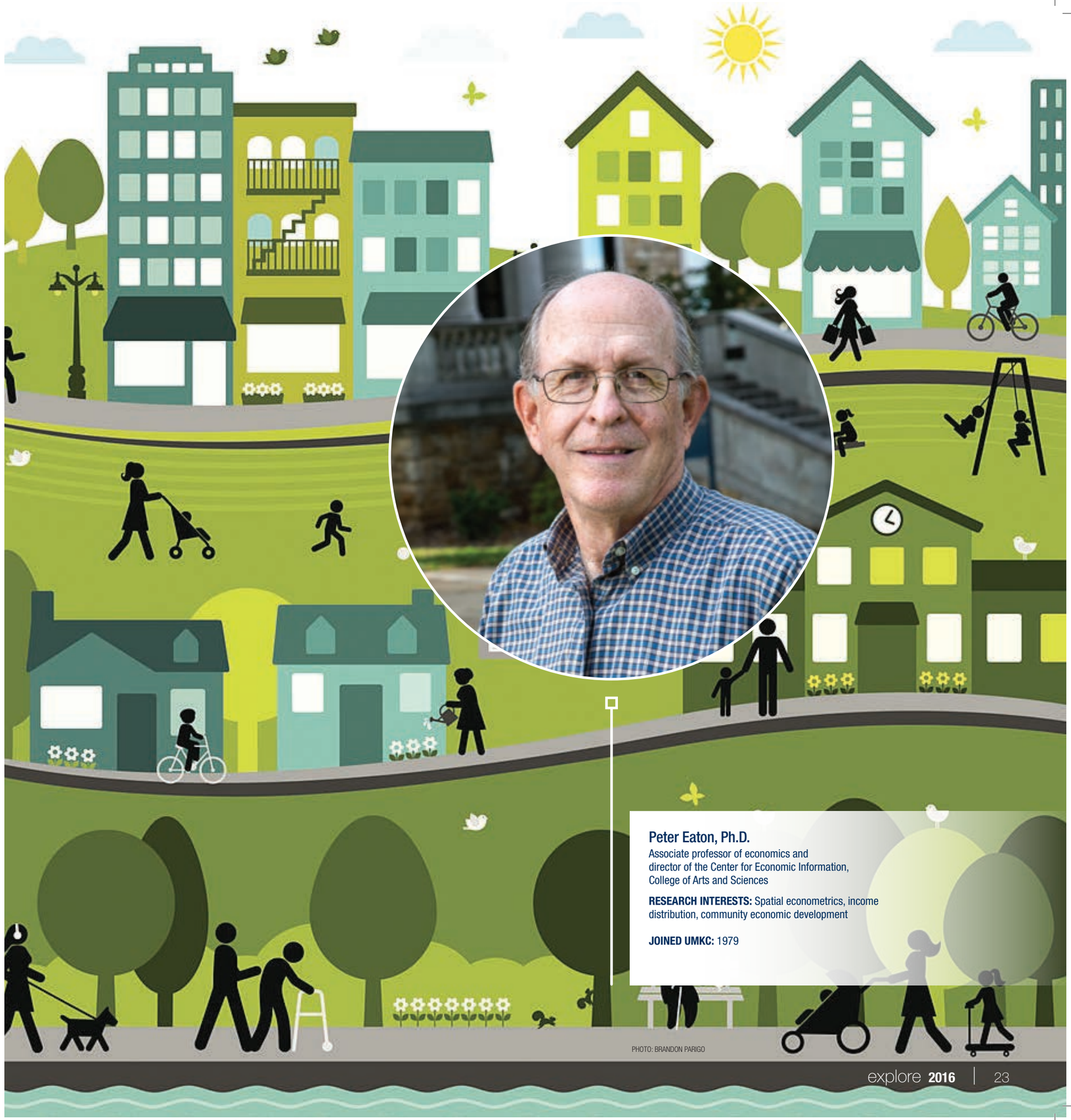
How does this strengthen the relationship of UMKC and the city?

Access to information is key — good information informs good decisions. Data should be available democratically, not just for those with resources. UMKC is focused on urban issues and helping underserved areas of the metro. The common perception is that within a university, academics are protective of their own research, but we want to share — and neighborhoods use our data all the time. Ultimately, working together with partners in the community, we will be able to do more than we could by working separately.

— Hallie Spencer

explore online

→ **READ EATON’S FULL INTERVIEW AT** INFO.UMKC.EDU/RESEARCH.



Peter Eaton, Ph.D.
Associate professor of economics and director of the Center for Economic Information, College of Arts and Sciences

RESEARCH INTERESTS: Spatial econometrics, income distribution, community economic development

JOINED UMKC: 1979

PHOTO: BRANDON PARIGO

data points

MORE THAN NUMBERS

UMKC IS A RESEARCH UNIVERSITY ON THE MOVE.

UMKC plays a major role in the Kansas City metropolitan area as an educator, employer and research leader. The following data are more than just numbers — they reflect the excellence of UMKC faculty, whose creative endeavors set us apart as a research university and economic engine in the heart of Kansas City.

$142 million
Total of proposed projects

207
Number of extramural awards received by UMKC faculty in FY 2015

17
Patent applications filed

492
Number of proposals submitted in 2015, compared to 436 in 2014

$33.6 million
Total research expenditures

$32.7 million
Amount awarded to UMKC research and related projects in FY 2015

57%
Percentage of total dollars coming from the federal government

23%
Yield on proposed projects

90
Number of invention disclosures filed (2013-2015)

Looking to the Future

EyeVerify Inc., a Kansas City startup previously featured in Explore, has been acquired by Ant Financial Services Group, the world's leading online and mobile financial services provider and operator of Alipay.

The startup is based on biometric eye-scan technology developed by UMKC School of Computing and Engineering Associate Professor Reza Derakhshani, Ph.D., who serves as the chief science officer at EyeVerify.
The technology is patented and currently being commercialized through an exclusive licensing agreement with UMKC. The university will receive a portion of the proceeds through its license with the company and the two organizations plan to continue to their research partnerships into the future.

Derakhshani (left) works with a graduate student (right) to collect ocular biometric data in the CIBIT Research lab.

PHOTO: DAN VIDETICH PHOTOGRAPHY

Translating Ideas into Innovation

Office of Research and Economic Development
5211 Rockhill Road
Kansas City, MO 64110

816-235-5600
ORS@umkc.edu

info.umkc.edu/research

UMKC

University of Missouri-Kansas City