



TEXAS BIOMEDICAL
RESEARCH INSTITUTE

WINTER 2014/2015

PROGRESS

Enhancing lives through discovery™

New Regenerative Medicine Program

Scientists work with stem
cells for novel potential
therapies

PAGE 9

INSIDE:

Breaking Bones

Osteoporosis study combines
engineering & genetics in
search of answers

PAGE 6

CELEBRATING PROGRESS



Thanks to the generous support of donors, Texas Biomed completed construction on and dedicated the Earl Slick Research Center in March 2014. The 70,000 square foot laboratory and scientific support facility includes 15 research laboratories, a high-containment laboratory and other highly specialized shared labs. The Center is home to the Southwest National Primate Research Center, along with the new regenerative medicine and AIDS research programs highlighted in this issue. (Pictured from L to R: Board of Trustee Chairman Richard T. Schlosberg III, Dr. Ronald K. Calgaard, John C. Kerr, Lynn Ives, John R. Hurd, Walter Embrey, Phyllis Slick Cowell, John Cowell, Helen Groves and Emory Hamilton)

LETTER FROM THE CHAIRMAN

“CHANGE BEGETS
PROGRESS, AND PROGRESS
IS HAPPENING EVERY DAY
AT TEXAS BIOMED. WE WILL
CONTINUE TO *celebrate
our evolution and
embrace innovation
and collaboration.*”

DEAR FRIENDS,

JOHN F. KENNEDY SAID, “CHANGE IS THE LAW OF LIFE. AND THOSE WHO LOOK ONLY TO THE PAST OR PRESENT ARE CERTAIN TO MISS THE FUTURE.”

TEXAS BIOMEDICAL RESEARCH INSTITUTE HAS EXPERIENCED SIGNIFICANT CHANGE THIS PAST YEAR. SEVERAL DISTINGUISHED SCIENTISTS HAVE JOINED OUR TEAM, NEW LEADERSHIP IS IN PLACE IN MANY PARTS OF THE ORGANIZATION AND THE INSTITUTE’S \$27 MILLION EARL SLICK RESEARCH CENTER WAS DEDICATED IN MARCH.

The new building, funded by the generous support of donors, represents the public face of the campus and now houses both research and administrative personnel for Texas Biomed and the Southwest National Primate Research Center. The Center gave us room to recruit impact researchers and also consolidate laboratories previously housed in multiple buildings around the campus, creating efficiencies and fostering collaboration.

In June of this year, Kenneth Trevett, President and CEO of Texas Biomed, retired after six years of dedicated service to the organization. Dr. Robert Gracy, who replaced Dr. John VandeBerg as Chief Scientific Officer upon Dr. VandeBerg’s retirement in February, was named interim President and CEO. Dr. VandeBerg was also the Director and Founder of the Southwest National Primate Research Center (SNPRC), and that position was filled by Dr. Robert Lanford. Dr. Lanford has been a member of the Department of Virology and Immunology for more than 30 years, working on cures for hepatitis B and C viruses, and was one of the original members of the Primate Research Center.

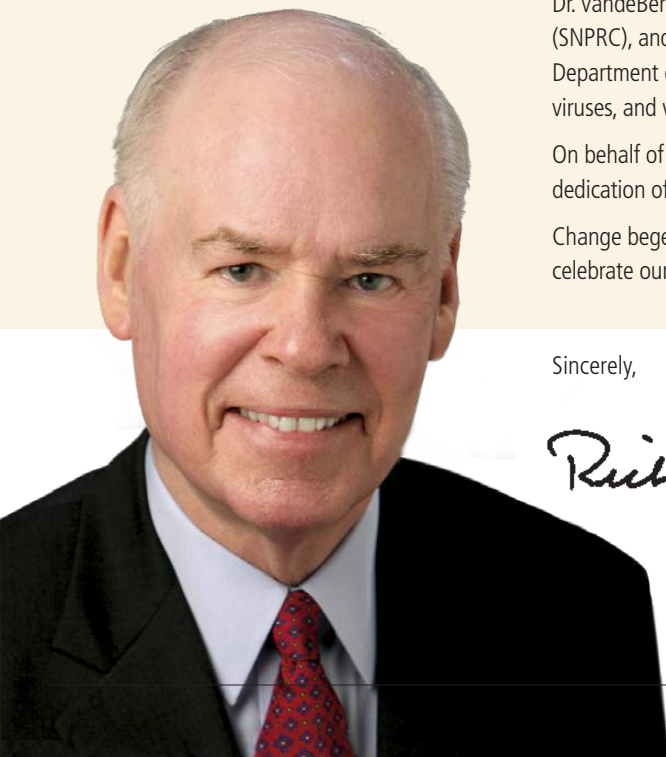
On behalf of the highly engaged and committed board of trustees, we are excited about the quality and dedication of the researchers and leadership’s commitment to scientific discovery.

Change begets progress, and progress is happening every day at Texas Biomed. We will continue to celebrate our evolution and embrace innovation and collaboration.

Sincerely,

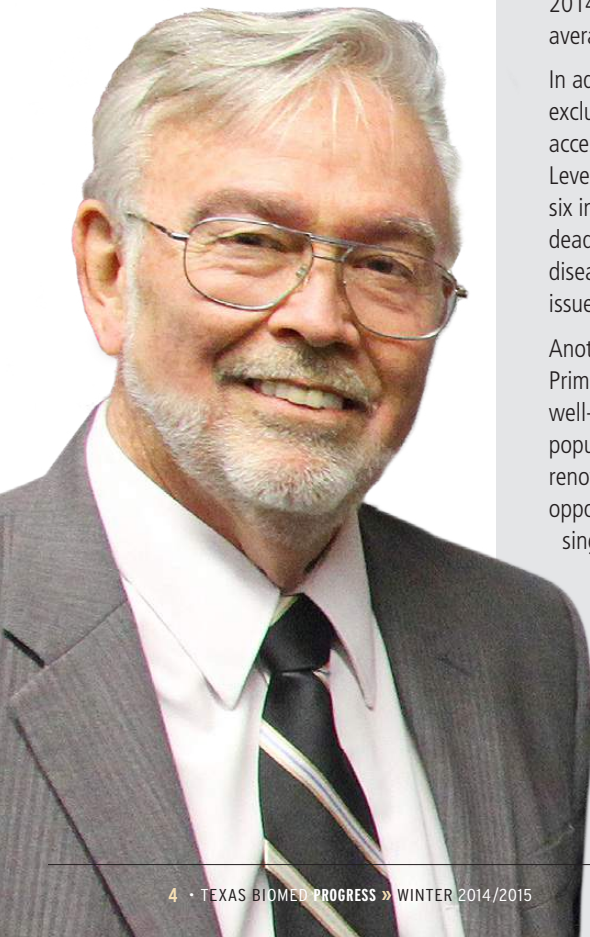


Richard T. Schlosberg III
Chairman of the Board of Trustees



LETTER FROM THE INTERIM PRESIDENT/CEO

“TEXAS BIOMED
*has the ability
and the resolve
to research* THE
MOST COMPLEX,
DEADLY AND
DEBILITATING
DISEASES.”



DEAR FRIENDS AND COLLEAGUES,

CRITICAL TO THE SUCCESS OF ANY GREAT INSTITUTION IS ITS PEOPLE: STAFF, COLLABORATORS AND DONORS. TEXAS BIOMED CANNOT ASK FOR GREATER CHAMPIONS FOR BOTH THE INSTITUTION AND BIOMEDICAL RESEARCH AS A WHOLE. FROM OUR SCIENTISTS TO OUR HIGHLY ENGAGED BOARD OF TRUSTEES, WE ARE COMPRISED OF THOUGHTFUL PEOPLE WILLING TO TAKE EDUCATED RISKS TO ACCOMPLISH GREAT SCIENTIFIC DISCOVERY AND IMPACT THE HEALTH AND WELL-BEING OF PEOPLE WORLDWIDE.

Researchers at Texas Biomed continue to be highly competitive for funding among peers in an environment where access to research support remains a challenge. Scientists at independent research institutes such as Texas Biomed are fortunate they can focus entirely on research projects, rather than splitting time between research and teaching, patient care or other responsibilities. As a result, they will likely have the best chance of being funded and of successfully conducting that research. Almost 25 percent of the proposals Texas Biomed submitted to the National Institutes of Health between 2009 and 2014 received funding compared with the national average of 19.3 percent in the same time period.

In addition to the opportunity to concentrate exclusively on research, Texas Biomed faculty have access to a unique set of assets. The BioSafety Level-4 (BSL-4) research laboratory, one of only six in the country, allows scientists to study the deadliest of pathogens, including Ebola virus disease as highlighted on the back cover of this issue, while being fully protected from exposure.

Another unique asset is the Southwest National Primate Research Center, which maintains a well-characterized, pedigreed non-human primate population to aid in all areas of research. Our renowned Genetics Department is exploring new opportunities in metabolomics, proteomics and single-cell genetics, as highlighted in a brief about malaria research on page 19. And, our recently recruited stem cell researchers, introduced in this issue's cover story, have launched a fresh field of study at Texas Biomed, and we are excited to welcome Dr. Tiziano Barberi and Dr. Marcel Daadi to the Institute.

Texas Biomed has the ability and the resolve to research the most complex, deadly and debilitating diseases. This requires collaboration with other research organizations. Investigators and engineers at our sister organization, Southwest Research Institute (SwRI), beautifully complement our researchers in the medical sciences. An example is the joint team of SwRI engineers and our Genetics Department scientists who are working together to better understand osteoporosis, as outlined in the feature article on page 6. We have many collaborations with the UT Health Science Center San Antonio and the Barshop Institute for Longevity and Aging Studies, as well as the military. And, vaccine research has taken a huge step forward with the development of the Vaccine Development Center of San Antonio, a joint program of Texas Biomed, UTHSCSA, SwRI, and the University of Texas at San Antonio.

Our internal leadership teams are also putting in place new models for collaboration, including more innovative approaches to bring discoveries to market. The key to our success is teamwork — the practice of working with experts who contribute different skills and insights to accomplish a goal that could not be achieved by individuals.

Sincerely,

A handwritten signature in black ink, appearing to read 'R. Gracy'.

Dr. Robert Gracy
Interim President/CEO



LETTER FROM DEPARTMENT LEADERS AND PRIMATE CENTER DIRECTOR

— DR. ROBERT LANFORD, DR. MICHAEL OLIVIER, DR. JEAN PATTERSON

THE FIELD OF BIOMEDICAL RESEARCH IS ALWAYS CHANGING; IT IS BECOMING FASTER, MORE COMPETITIVE, WHILE AT THE SAME TIME MORE COLLABORATIVE. SCIENTISTS ARE LOOKING BEYOND THE MICROSCOPE TO THE BEDSIDE FOR WAYS IN WHICH BASIC RESEARCH THAT IS THE FOUNDATION OF ALL FUTURE SCIENCE CAN TRANSLATE INTO LONGER, HEALTHIER LIVES.

As problem solvers and thought-leaders in the industry, we must anticipate and position ourselves on the cutting-edge of science that is relevant and critical to human health.

To that end, the Southwest National Primate Research Center (SNPRC) has established the Primate Center Program on Regenerative Medicine and recruited two leaders in stem cell research, Dr. Marcel Daadi and Dr. Tiziano Barberi.

Dr. Daadi works in the area of neural stem cells as a therapy for Parkinson's disease, post-traumatic stress disorder and traumatic brain injury, while Dr. Barberi works on retinal epithelia cells for repair of eye disease and trauma, as well as stem cell approaches to muscular diseases.

The stem cell program for Parkinson's has already received a collaborative grant from UT Health Science Center San Antonio and the Barshop Institute for Longevity and Aging.

SNPRC is expected to receive funding on a cooperative agreement with NIH worth more than \$8 million to support the colony of macaque monkeys for the next four years. The grant supports core laboratories in both the Departments of Genetics and Virology and Immunology. One of the highlights of this grant is the novel initiative to sequence the entire genome of most of the macaques in the colony during this funding cycle.

Dr. Ruth Ruprecht in Virology and Immunology will utilize these macaques to support her new HIV vaccine initiative funded by the Bill & Melinda Gates Foundation as highlighted on page 8.

Vaccine work has never received more attention than it has this year and for good reason. The world's attention turned to West Africa as the

INVESTING IN THE CONTINUED GROWTH OF OUR TEAMS, FOSTERING A DEVELOPING SPIRIT OF PARTNERSHIP AND PROMOTING EVEN GREATER COMMUNICATION THROUGHOUT THE ORGANIZATION WILL BE A *significant priority moving forward as we continue to advance the pursuit of knowledge and strive to improve lives.*

Ebola virus epidemic has killed thousands and has crossed geographic borders to land in the United States and Europe.

Texas Biomed scientists are working furiously, as they have since 2004, on understanding the virus in an effort to develop a vaccine, including evaluating potential vaccines and measuring signs of immunity for new vaccines for Ebola and Marburg viruses.

In addition to vaccine development, researchers are focused on novel technologies to improve diagnostics and tests for the Ebola virus, and

the virology and immunology team has met with the Bill & Melinda Gates Foundation to discuss the repurposing of drugs as antivirals against Ebola virus.

Basic research, which provides the building blocks for applied and translational studies, remains at the heart of this institution, and funding is strong for much of these studies.

An area of significant opportunity is in Texas Biomed's unique capability of analyzing complementary genetic data from human and nonhuman primate studies to examine comprehensive changes caused by genetic variation. Our Genetics Department has the ability to maximize the genetic data we have from both human and nonhuman primate studies.

Scientists in the Genetics Department are working on better understanding the underlying mechanisms contributing to diseases like obesity, diabetes, heart disease, hypertension, hearing loss, neurological disorders and osteoporosis, as well as parasitic diseases, such as malaria and schistosomiasis. They seek to identify novel targets for drug treatment and development of enhanced diagnostics for these diseases. And, the Department continues research into the genetic components of heart disease among American Indians and Mexican-Americans.

With more than 200 research projects across the institution, there is great possibility for internal collaboration and knowledge transfer. Investing in the continued growth of our teams, fostering a spirit of partnership and promoting even greater communication throughout the organization will be a significant priority moving forward as we continue to advance the pursuit of knowledge and strive to improve lives.

Sincerely,

Dr. Robert Lanford,
Director of the Southwest National Primate Research Center

Dr. Michael Olivier,
Interim Chair, Department of Genetics

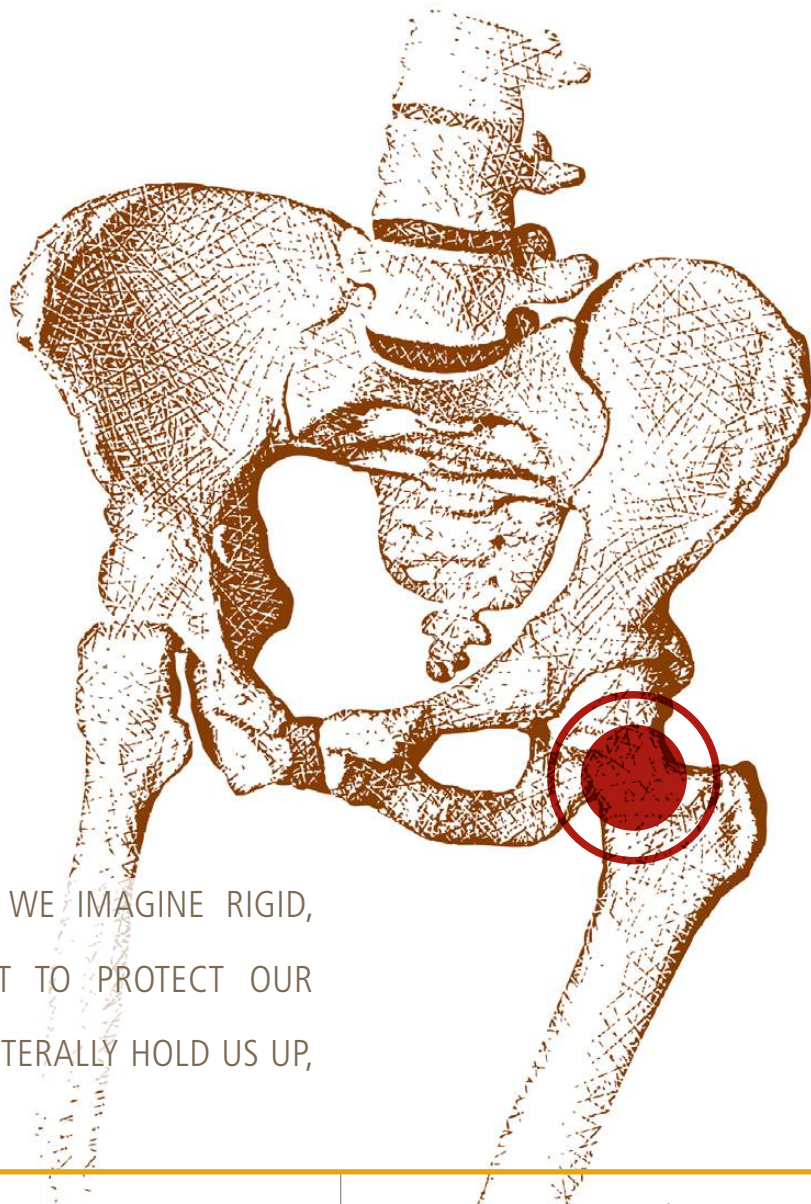
Dr. Jean Patterson,
Chair, Department of Virology/
Immunology



Getting to the heart of our skeleton

Geneticists partner with engineers to examine bone qualities linked to osteoporosis

WHEN MOST PEOPLE THINK OF BONES, WE IMAGINE RIGID, STRONG STRUCTURES THAT ARE MEANT TO PROTECT OUR INTERNAL ORGANS FROM DAMAGE AND LITERALLY HOLD US UP, UNTIL ONE DAY, THEY DON'T.



The day you step off a curb and land on your hip or trip over your grandson's lego and fracture a wrist; that day, you realize your bones are fragile, but what makes your bones more fragile than someone else's?

According to the National Institutes of Health, more than 40 million Americans are at risk for osteoporosis and bone fracture. Osteoporosis is a disease in which people suffer from not enough bone mass or from deterioration of bone tissue. This disease puts individuals at an increased risk of fracturing or breaking a bone.

Current standards for measuring bone strength rely on bone mineral density scans. This measures how much bone a person has. If you have a lot of bone, you're thought to be at lower risk for developing osteoporosis. And, current treatment strategies for osteoporosis are aimed at either maintaining or increasing the amount of bone a person has.

"What we currently look at is only one dimension of bone fragility, but what it is not telling us is what are the other variables involved in bone

"NEARLY 50 PERCENT OF ALL PEOPLE WHO SUFFER FRACTURES DO NOT HAVE LOW BONE DENSITY, WHICH TELLS US *something else is wrong.*"

— LORENA HAVILL, PH.D.

health," said Dr. Lorena Havill, Associate Scientist in the Department of Genetics at Texas Biomed. "Nearly 50 percent of all people who suffer fractures do not have low bone density, which tells us something else is wrong."

Havill has been working with Dr. Daniel Nicolella, an engineer at the Southwest Research Institute, for several years now to look more closely at the diverse factors contributing to bone strength beyond bone density.

The body's skeleton is, in fact, a living, growing organ that is meant to be both flexible and strong.

Bones are comprised of cells that form collagen, which is a soft protein. The collagen combines with calcium phosphate, a mineral, to strengthen the tissue. Bones have a spongy interior and a hard exterior.

And, as Havill explained, our bones are constructed much like a bridge that needs the right amount of high-quality material, arranged in just the right way to build a sturdy structure.

"Our bones need first-class building blocks, the collagen and minerals in our bones, that when connected together the right way create stability, and you need enough of this high quality material to form a strong bone," Havill explains.

It's the quality and the structure of the bone that Havill and Nicolella are most interested in.

Nicolella said of SwRI's role in the study, "We are performing the material and biomechanical characterization of the bones from the nanoscopic level, which are the basic building blocks of the collagen and minerals that form the bone, to the microstructural level, which is where the

collagen and mineral composite fibers form into the bone tissue, and then eventually the whole bone organizational level. The goal is to gain a better understanding of how the organization of bone constituents come together across each of these length scales to form a bone that is biomechanically strong enough for everyday living."

At each level, Nicolella's team is measuring how stiff the bones are, how cracks grow through them, and ultimately, the strength of the whole bone.

"There are lots of combinations of traits that the skeleton needs to maintain strength for both everyday function and if faced with a unique impact, such as a fall," Havill said.

To capture the diverse data set necessary for this study, Havill and Nicolella have assembled a research collaborative from across the country, including Dr. Todd Bredbenner, an engineer in Nicolella's group at SwRI, which has proven to be highly critical in this effort. Bones undergo collagen analysis with Dr. Jeffrey Nyman, Assistant Professor of Orthopedic Surgery and Rehabilitation at Vanderbilt University Medical Center. Microdamage to the bone is analyzed by Dr. Matthew R. Allen, Assistant Professor at Indiana University School of Medicine. And, Dr. Karl Jepsen, Professor of Orthopedic Surgery, Medical School and Professor of Biomedical Engineering, College of Engineering and Medical School at the University of Michigan, Ann Arbor is consulting on data interpretation.

"In the past, researchers have looked at individual bone components, but this is the first study linking all of it together," Havill said.

"We can put all these factors into a model and let the data tell us which combination of traits separates the strong bones from the weak."

Capturing and characterizing the properties of each bone and then running an analysis of those properties against the strength of a bone is essential to determining which of those factors and how those factors play a role in development of stronger and weaker bones.

"Essentially, we are looking for combinations of variables that put someone at higher risk for fracture," Havill said. "What we hope is that by characterizing a better measurement for the risk of bone fracture, we can identify and create more targeted therapeutics rather than putting everyone on medications to increase bone density when they may not need it."

The National Institutes of Health grant for this study runs through 2016, and Havill expects to have answered the question of what other variables are at play besides bone density by the end of the study. Further development of osteoporosis treatments will depend on the

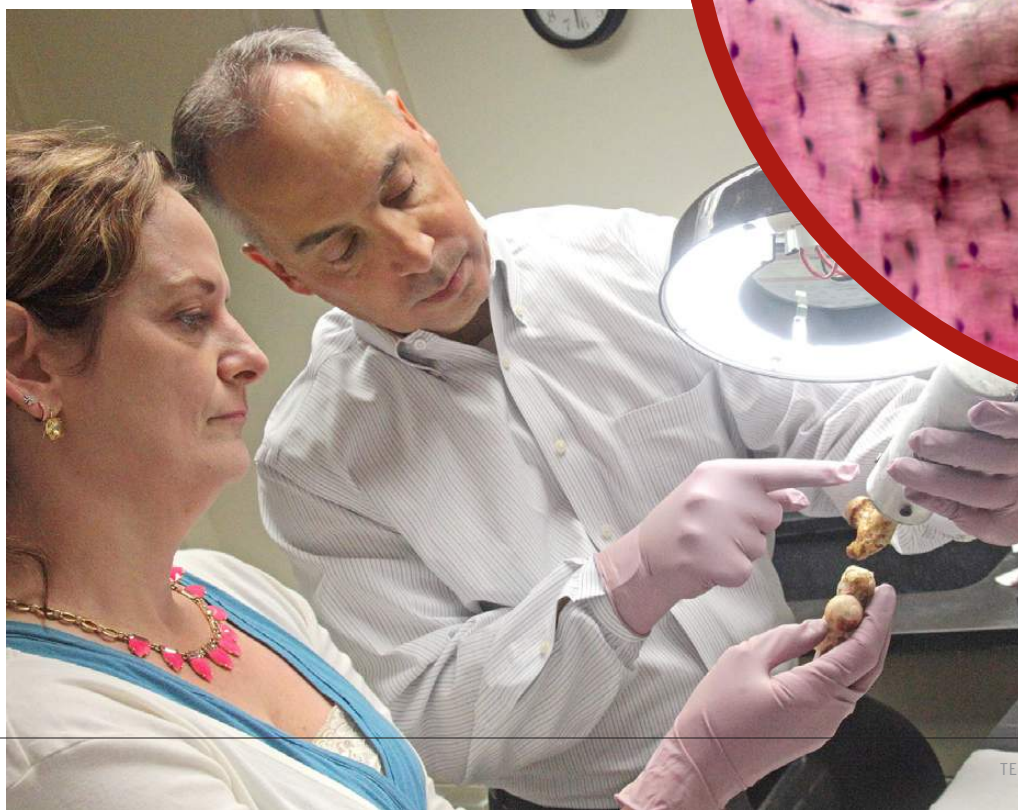
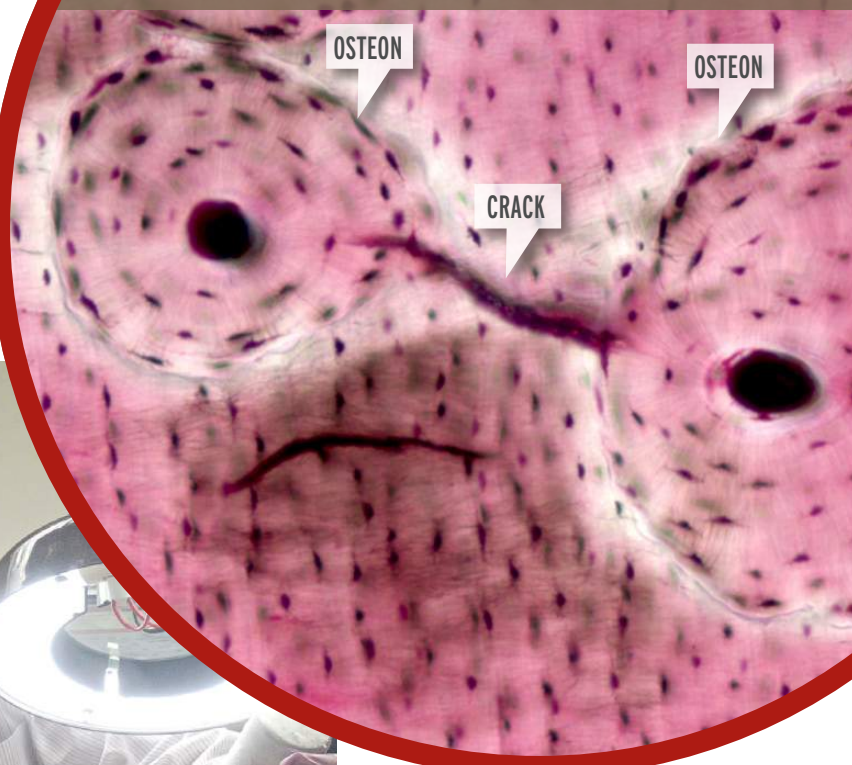
risk factors they find.

Havill said that targeted therapy for osteoporosis is the end goal, but a win would also be the development of new diagnostics that can focus on an individual patient. Whether through genetic blood testing for biomarkers of these bone health characteristics or engineering mechanisms that can scan for these traits, diagnosing patients on an individual basis would be a big step forward.

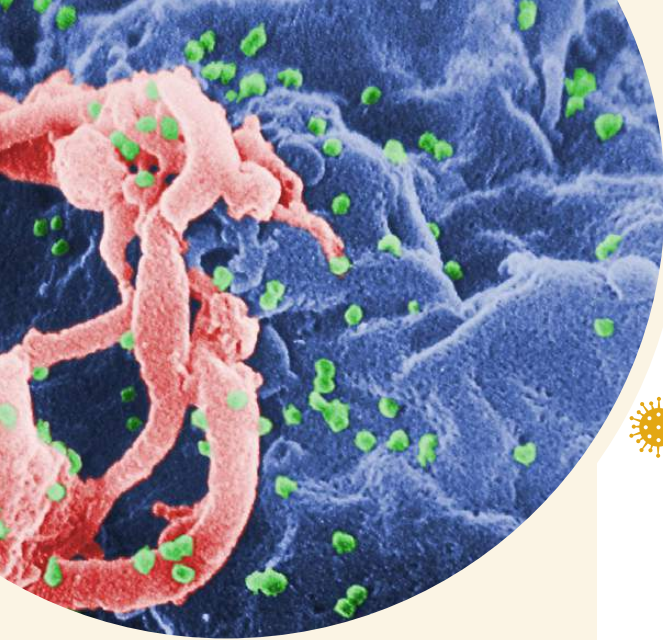
Havill added, "This has the potential to be personalized medicine at its best, where we can diagnose an individual deficit and treat for that." ■

BREAKING THE CODE

This image shows a **crack** (microdamage) between two **osteons**. **Osteons** are cylindrical, functional structures found in compact bone. Texas Biomed studies include understanding how osteons affect cracks and damage (i.e., keep them from going all the way through the bone cortex and resulting in a major break).



Dr. Lorena Havill and Dr. Daniel Nicolella are reviewing the method for mechanically testing baboon femurs to ensure correct simulation of the forces that would be encountered during a fall on a hip.



Scanning electron micrograph of HIV-1 budding (in green) from cultured lymphocyte.

Photo Credit: Cynthia Goldsmith, Centers for Disease Control and Prevention



Promising HIV vaccine trial begins this year

*Funding provided by the
Bill & Melinda Gates Foundation*

“MYMETICS’ HIV VACCINE CANDIDATE IS UNIQUE IN ITS DESIGN ... IT WAS ENGINEERED *to stop HIV from crossing the mucosal barriers – with promising initial results.*”

— DR. RUTH RUPRECHT
DIRECTOR, TEXAS BIOMED
AIDS RESEARCH PROGRAM



Human Immunodeficiency Virus or HIV continues to be a leading global health threat. There is still no cure and no vaccine to fight against HIV infection. According to the World Health Organization, nearly 2.3 million people became newly infected with HIV and 1.6 million people died of AIDS in 2012.

Texas Biomed scientists are now studying the efficacy of an HIV vaccine candidate that is taking a unique approach to its method of protection. Dr. Ruth Ruprecht, Scientist & Director of the Texas Biomed AIDS Research Program, will lead the study and says this particular vaccine focuses on stopping transmission of HIV at the mucosal barrier.

“Mymetics’ HIV vaccine candidate is unique in its design,” Ruprecht said. “First, it uses building blocks from a special part of the HIV envelope protein, called gp41, and second, it was engineered to stop HIV from crossing the mucosal barriers – with promising initial results. We hope to confirm previous findings and learn more about this vaccine’s mechanism of action in providing mucosal protection.”

According to a news release from Mymetics Corporation, the company that developed the vaccine, this new study follows a smaller study at the Institute of Laboratory Animal Science (ILAS) in Beijing, China that showed promising results. In it, a two-component vaccine protected all monkeys against repeated AIDS virus exposures from persistent infection.

According to Ruprecht, researchers traditionally have focused on creating a vaccine that elicits specific blood antibodies or cytotoxic T cells, but neither approach has been very successful to date. She adds that

roughly 90 percent of all new HIV infections occur through mucosal exposure, so a vaccine that can prevent the virus from entering the body through this route could have a significant impact on transmission rates.

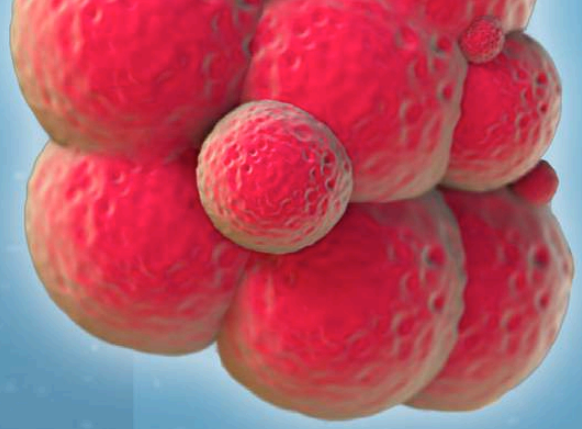
This study builds on previous studies that have shown certain people are not infected with HIV, even though they are exposed to it very frequently. Women and men who produce IgA antibodies against the HIV gp41 envelope protein in their mucosal secretions have been found to display resistance to HIV transmission and infection.

Ruprecht added that when deciding to do this study on the two-component vaccine, it made sense to also test just one component of the vaccine at the same time. One of the vaccine components has shown a strong safety and tolerance profile in a Phase I clinical trial in human volunteers. If the one-component vaccine proves effective, this vaccine could potentially move through the drug development pipeline faster, as it would be easier and more cost-effective to produce.

The vaccine developer, Mymetics Corporation, is headquartered in Switzerland and specializes in virosome-based vaccines to prevent transmission of human infectious agents across mucosal membranes.

CEO of Mymetics Ronald Kempers said in the news release, “We are very honored and pleased about our collaboration with Dr. Ruth Ruprecht, a leading expert in the HIV field.”

The study, expected to last 18 months, was funded with a \$1.85 million grant from the Bill & Melinda Gates Foundation. ■



RESEARCH NEWS

Regenerative Medicine: Battling disease at the cellular level

WHEN THE TERM STEM CELL RESEARCH WAS USED IN ITS EARLY DAYS, IT COULD EVOKE IMAGES STRAIGHT OUT OF A SCIENCE FICTION MOVIE WHERE A PERSON REGENERATES A MISSING LIMB OR ORGAN.

These days, stem cell scientists are working on various genetic disorders that prove modern regenerative medicine is anything but fiction with great potential to treat and cure disease.

It is this potential that drives stem cell researchers to start 'in the beginning.'

All living things are comprised of cells, and stem cells are the early stage cells that differentiate into the various cell types that make up who we are by becoming our brain cells, liver cells, heart cells, etc.

Take a step back, and embryonic stem cells are the most primitive form of stem cells; they are also called pluripotent stem cells (PSCs). Pluripotent cells are unspecialized cells that can form virtually any cell of our body.

Scientists are now able to keep these most primitive cells in a petri dish and determine the fate of these cells by mimicking the natural developmental process in the lab, essentially turning a pluripotent stem cell into a brain cell, muscle cell, eye cell and so on.

Thanks to scientific innovation, researchers can also now take adult body cells, such as a skin or blood cell and turn back the clock to create what are called induced pluripotent stem cells (iPSCs).

The promise of this new technology is that researchers can now either create healthy iPSCs that can be used as a treatment for a variety of diseases or scientists can create "diseased" iPS cells to determine the impact of different therapies on these diseased cells. Thus, diseased iPS cells can become part of the drug development pipeline.

THANKS TO SCIENTIFIC INNOVATION, RESEARCHERS CAN ALSO NOW TAKE ADULT BODY CELLS, SUCH AS A SKIN OR BLOOD CELL AND *turn back the clock to create stem cells.*



(Pictured from L to R):
Marcel Daadi, Ph.D. and Tiziano Barberi, Ph.D.

“ALL THE TECHNOLOGY
is coming together.”

— MARCEL M. DAADI, PH.D.

SNAPSHOT

Marcel M. Daadi, Ph.D.,
Associate Scientist & Director Stem Cells
& Regenerative Medicine, Southwest
National Primate Research Center

History:

Daadi completed his master and doctoral training at the National Centre for Scientific Research at the Université de la Méditerranée in Marseille, France. He completed post-doctoral training at the University of Calgary School of Medicine in Canada.

Background:

Daadi's 20-year career took him from a senior scientist role at Layton Bioscience, a biotech company focused on the development and manufacturing of a neural product to treat stroke patients, to Stanford University.

This is where Texas Biomed's Primate Center Program on Regenerative Medicine and the new stem cell research teams come in.

Dr. Marcel Daadi has more than 20 years of experience conducting research in stem cell biology and preclinical development of therapies that use stem cells to treat debilitating diseases. His primary focus is on developing a stem cell treatment for Parkinson's disease, which is a consequence of the death of the brain cells that produce dopamine.

Prior to joining Texas Biomed staff, Daadi was a consulting faculty member at Stanford University.

While at Stanford, Daadi developed and patented technology to manufacture neurons and neural stem cells from pluripotent stem cells. Daadi's strategy is to take a skin biopsy from a person, use those skin cells to create iPS cells, and then to treat the iPS cells with growth factors that cause them to differentiate into healthy brain cells that produce dopamine.

These dopamine-producing neurons can then be implanted into the brain of a Parkinson's patient, replacing the dead and dying cells and restoring brain function.

Daadi's work will first be tested in monkey models at Texas Biomed and could pave the way for clinical trials in humans.

In addition to developing therapeutic stem cell products, Daadi is engaged in collaborative partnerships assessing the safety of stem cell transplantation, developing devices and methods for delivering cells into specific regions of the brain, and non-invasive imaging methods for monitoring the survival of the implanted cells and their functionality.

“Novel technologies for producing, storing and injecting stem cells are rapidly progressing these days,” Daadi said. “All the technology is coming together. We have the ability now to manufacture, store, deliver and monitor long-term the function of stem cells in the diseased organs of the body (injecting healthy cells into diseased cells to reproduce and overcome the disease). These same cells can be used for assays in drug discovery, whereby we can take diseased iPSCs, put them in a dish, multiply them and then test the effectiveness of a variety of drugs.”

While Daadi's primary interest lies in Parkinson's disease, the approach with stem cell

MATURE CELLS

Today's stem cell research can now utilize adult cells rather than embryonic stem cells:

STEP 1: BIOPSY

A skin biopsy is taken from an adult.

PATIENT

TRANSPLANTATION

Modified cells can be replaced in humans for therapy. Or...

DISEASE-AD CELL TYPE

Cells can be made from diseased cells

DISEASE MODELED

Cells are then used in drug discovery and compound screening.

STEP 5: DIFFERENTIATION

iPS stem cells are grown to form specific types of human cells.

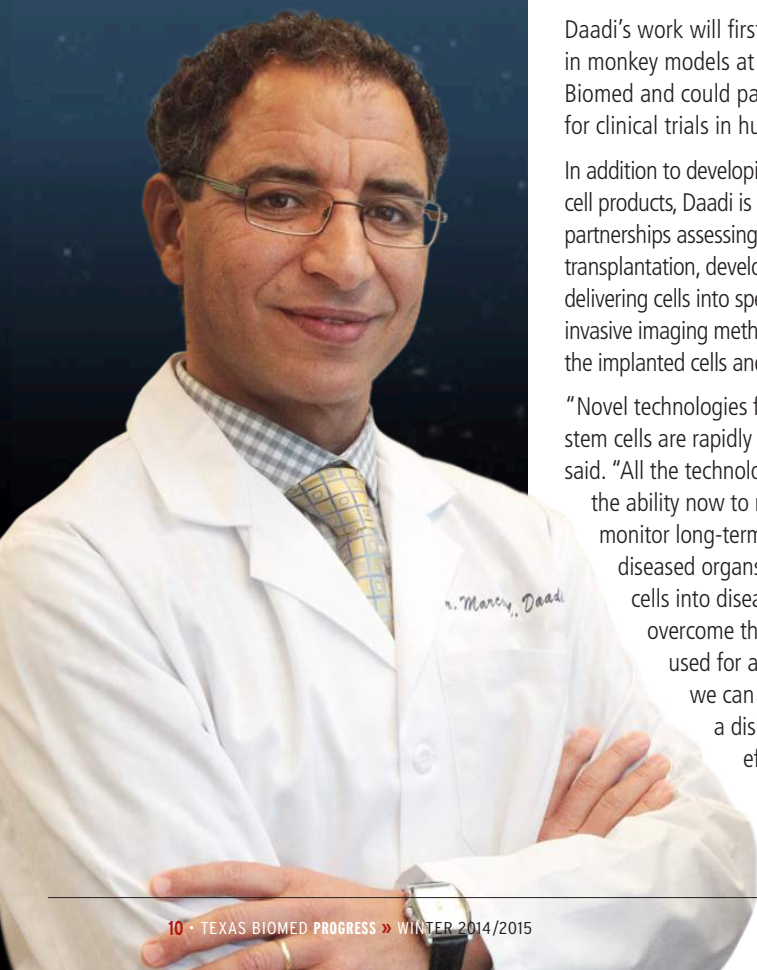
STEP 4: iPS

SELF RENEWAL

therapy holds similar promise for treatment of post-traumatic stress disorder, traumatic brain injury and stroke, all of which Daadi is studying.

Dr. Tiziano Barberi who joined Texas Biomed from Melbourne Australia where he was an associate professor at Monash University sees great promise in regenerative medicine over the next five years or so.

His primary areas of focus are the directed differentiation of PSCs and iPSCs, with the goal of using these cells to treat muscular dystrophy and eye disorders.



MATURE CELLS

Today's stem cell research can now utilize adult cells rather than embryonic stem cells:

STEP 1: BIOPSY

A skin biopsy is taken from an adult.

PATIENT

ADULT SKIN CELLS

STEP 2: REPROGRAMMING FACTORS

The adult cells are cultured and exposed to factors that reprogram the cells.

DISEASE-AFFECTED CELL TYPE

Cells can be made into diseased cells and controlled.

DISEASE MODELED

Cells are then used in drug discovery and compound screening.

STEP 3: INDUCTION OF PLURIPOTENCY

The reprogrammed cells contain components that promote the growth of iPS stem cells.

STEP 4: iPS CELLS

iPS cells resembling embryonic stem cells are harvested.

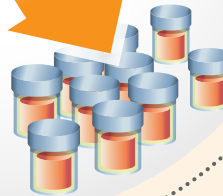
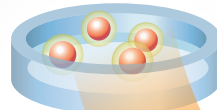
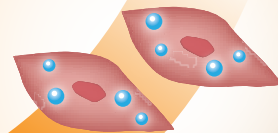
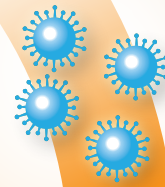
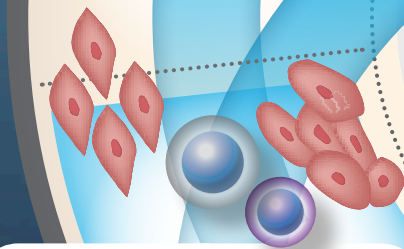
SELF RENEWAL

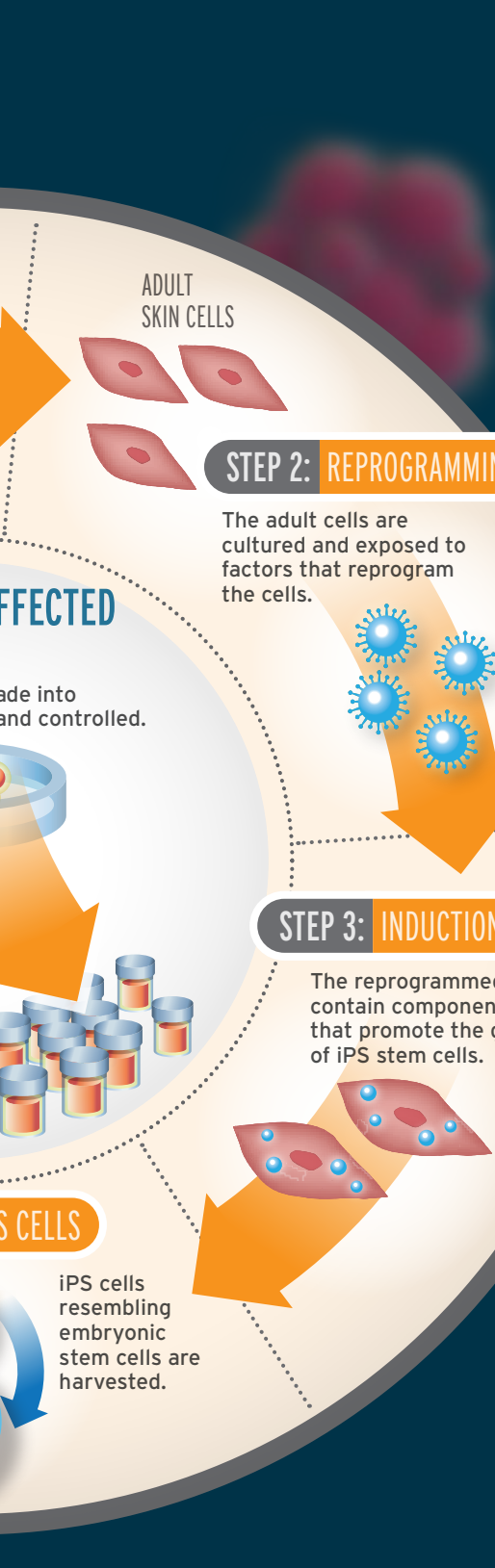
TRANSPLANTATION

Modified cells can be replaced in humans for therapy. Or...

STEP 5: DIFFERENTIATION

iPS stem cells are grown to form specific types of human cells.





needed to understand how they form. They solved this issue and published an efficient protocol to obtain pure muscle precursors from PSCs at the end of last year.

"What was once impossible is now becoming possible," Barberi said.

Work with stem cells has its challenges. In order to obtain the exact desired cell type from PSCs, it is imperative that scientists effectively purify these cells. Essentially, when generating a neuron cell, a muscle cell or an eye cell in a dish, researchers need to ensure that at the end of the process, all cells are exactly what they wanted, and if not, they have to use technology to isolate the wanted cells from the rest of the cultures.

In 2013, Barberi published a study that focused on the isolation and purification of lens epithelium from PSCs. This was an important step toward the understanding of human lens development, as well as potential regeneration or therapeutic applications for correcting lens disorders.

While regenerative medicine shows great promise and several recent studies at labs across the country have shown that stem cell therapy is possible, the therapy does not come without its challenges.

"We need to better understand delivery mechanisms," Barberi said. "One disease may allow us to provide directed therapy to the specific site of the disease, such as a brain cell or lung cell. However, other diseases such as muscular dystrophy, where it is a disease found throughout the body, does not provide such easy access to the diseased site."

Barberi also explained that recent clinical trials throughout the country involving stem cells are primarily aimed at showing this therapeutic intervention is safe. Researchers still need to prove efficacy of the therapy.

Both Barberi and Daadi are quick to point out that genetic diseases are complicated, and while stem cell therapy could potentially provide some relief from symptoms or even slow down the progress of many diseases, it will still take time to find a cure for many of these diseases.

But, the potential of regenerative medicine is firmly established, and Texas Biomed now has researchers committed to enhancing lives through discovery with stem cell research. ■

Barberi explains that muscular dystrophy is currently an incurable disease. His long-term hope is to use PSC-derived muscle precursor cells that he makes in the lab and replace the diseased muscle upon transplantation of these healthy muscle cells. For the short term, Barberi is optimizing procedures for functional tests in animal models.

"It was first basic scientific knowledge we were looking for," Barberi explained. In order to create healthy muscle cells, he and his team first

WHAT WAS ONCE
IMPOSSIBLE *is now*
becoming possible.

— TIZIANO BARBERI, PH.D.

SNAPSHOT

Tiziano Barberi, Ph.D., Associate Scientist & Head, Pluripotent Stem Cell Differentiation Lab, Southwest National Primate Research Center

History:

Barberi received a science doctorate degree in cell and molecular biology from State University La Sapienza in Rome, Italy, and a Ph.D. in Cell biology from Eberhard Karls Universität in Tübingen, Germany. He did his postdoctoral work at Memorial Sloan-Kettering Cancer Center in New York City.

Background:

Barberi has more than 20 years of experience in stem cell biology. Prior to his move to Monash University, he ran a stem cell lab at the Beckman Research Institute of City of Hope in Duarte, California.



TEXAS BIOMED PROFILE

Sharon Price: Dedication to the care of animals at Texas Biomed for nearly two decades

AN OATH IS A FORMAL PROMISE, GENERALLY TO TELL THE TRUTH OR DO SOMETHING WORTHY. SHARON PRICE, VETERINARY RESEARCH TECHNICIAN SUPERVISOR AT TEXAS BIOMED, HAS TAKEN AN OATH OF SERVICE TO CARE FOR ANIMALS IN RESEARCH.

Price "solemnly dedicates (herself) to aiding animals and society by providing excellent care and service for animals, by alleviating animal suffering and by promoting public health."

She has taken the veterinary technician oath since 1989 and says she does her job for the animals and for the research.

"We're here to give research the best model we can," Price said. "If you don't have healthy animals, you don't have a research project."

Price began her career 25 years ago as a weekend and holiday caretaker at the Southwest Research Institute (SwRI).

SNAPSHOT:

Name: Sharon Price

Most Recent Position: Veterinary Research Technician Supervisor, overseeing a team of 10 and oversees the clinical care of baboons, macaques.

Years at Texas Biomed: 17

Background: Began her career as a weekend and holiday caretaker at the Southwest Research Institute (SwRI). She later transitioned fulltime to Texas Biomedical Research Institute.

She became a full-time research technician and caretaker in 1991 and transitioned to Texas Biomedical Research Institute in 1997 when SwRI closed its primate research program.

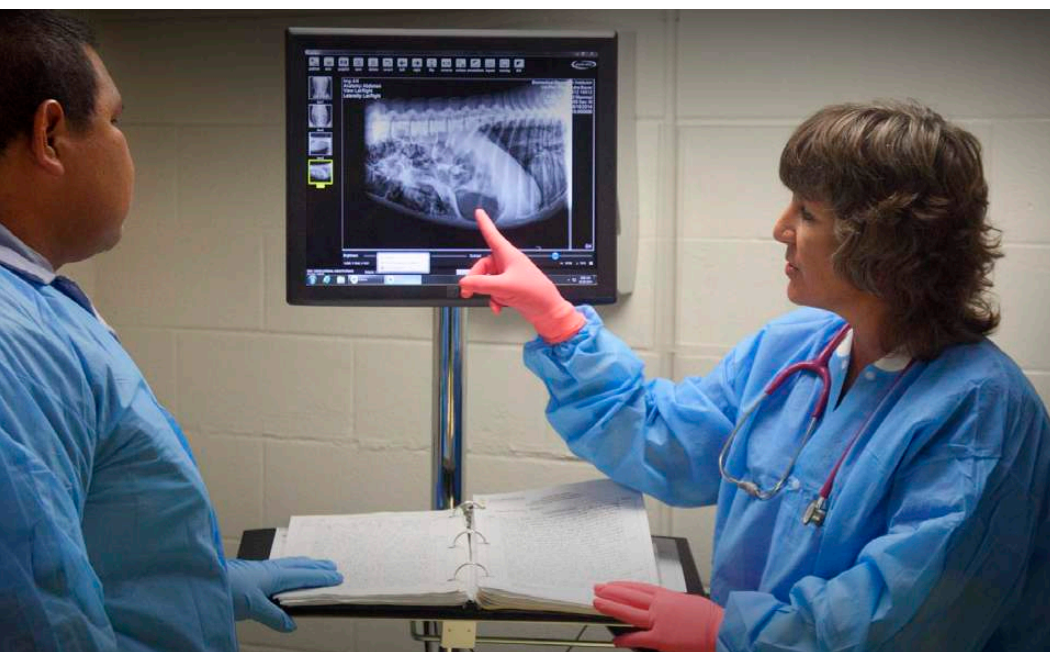
"At SwRI, I worked with all species associated with rodents and rabbits," Price recalled. "We did wildlife studies, so I worked with coyotes, hawks, rattlesnakes, raccoons and even seagulls. We had baboons and macaques on a smaller scale."

In her role at Texas Biomed, Price oversees a team of 10 veterinary technicians and caretakers with the baboon and macaque species, primarily. She supervises the clinical care for all baboons and macaques and also supports the colony management of these species. She also helps support marmoset and chimpanzee animal care staff for special clinical needs.

"When I started, I was going to school in the evenings to study animal health, and I met someone who worked at SwRI who helped me get my first job in the business," Price said. "I didn't really intend for it to be a career at the time, but it turned out to be."

Price said that her years working with animals in a clinical setting have provided an opportunity to see full circle the benefits of what she does.

"At SwRI, we tested cancer drugs, one of which my mother-in-law actually used in her treatment of breast cancer, and my grandmother actually has a cataract implant



Price and technician Abel Moncivais review an x-ray of a baboon's chest and abdomen.



“I’VE BEEN IN THIS JOB LONG ENOUGH TO SEE THE RESULTS OF THE STUDIES I HAVE BEEN INVOLVED WITH AND SEE THAT THEY WERE *actually used to the benefit of my own family members.*”

that was tested in rabbits,” Price said. “I’ve been in this job long enough to see the results of the studies I have been involved with and see that these therapies were actually used to the benefit of my own family members.”

In addition to seeing early stage research benefit patients directly, Price said her work provides diversity and constant innovation, and the animals themselves are unique.

“I’ve never gotten bored,” Price said. “I learn something with each new study and the clinical side is ever changing. Just when you think you know enough, something new comes out.”

Currently, Price is working with baboons on several studies focused on maternal nutrition, as well as antiviral and vaccine studies involving macaques.

When talking about the animals, Price’s voice hints of respect and awe, explaining how baboons are a hearty species and macaques are tenacious and radical in their decisions but once she learned to communicate with them, they work very well with her.

“I dearly love animals,” explains Price, who has been around animals all her life and currently has nine cats, three dogs, and a tank full of fish at home.

Whether it is caring for an injured animal, providing medications, collecting blood samples or simply observing the animals, Price and the animal care team are critical to the Southwest National Primate Research Center and the pioneering research of Texas Biomedical Research Institute.

After all these years, Price values both the clinical and the scientific work done here, adding “I see wonderful things come out of it.” ■



Millionaires Next Door Create \$4 million Endowment

ENHANCING LIVES THROUGH DISCOVERY REQUIRES COMMITMENT AND VISION. IT INVOLVES THE EXTRAORDINARY CAPACITY FOR EVERYDAY PEOPLE TO IMAGINE A BETTER FUTURE. FROM HUMBLE BEGINNINGS TO THE ESTABLISHMENT OF A YOUNG SCIENTIST ENDOWMENT, MILTON S. AND GERALDINE M. GOLDSTEIN ARE TWO SUCH VISIONARIES WHO ARE APPLYING RESOURCES TOWARD A BETTER TOMORROW.

Texas Biomedical Research Institute is the beneficiary of a \$4 million gift from Milton and Geraldine Goldstein to create an endowment that assists promising researchers above the postdoctoral level. From modest, hard-working beginnings to the establishment of an enduring legacy, the Goldsteins are a true American success story.

Milton Goldstein was a naturalized US citizen born in Poland in 1927. He moved to San Antonio with his family in 1933. From the age of 11, he worked along with his father at one of the first self-service department stores based in San Antonio. He always had strong ambitions as an entrepreneur, and after World War II, he built and managed small and medium apartment complexes in San Antonio. Having received a degree in journalism from the University of Texas, he aspired to share his life lessons. In 1992, he wrote "Winner's Bible," his secrets for success in business and in life.

He met and married Geraldine in 1958. They lived in a 1950 vintage home in a modest, working class San Antonio neighborhood. They never had children but enjoyed spending time with their family and friends. They were frugal in both business and lifestyle. Milton's banker relates a story that Milton would regularly take out a short-term bank loan so that he could take the "2% net 10" discount then offered from construction suppliers. When their home was destroyed by fire, they moved into one of their apartments and rebuilt the home on the same foundation — only finishing the rooms of the house that they would use!

Milton and Geraldine always admired medical research and the vision of Texas Biomed's founder, Tom Slick. The Goldsteins' incredible story will continue for generations, as their gift impacts the future of our community and our world, by providing young scientists with a helping hand early in their career. ■

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Progress is a publication of the Texas Biomedical Research Institute. If you would like to be added to our mailing list or to update your mailing information, please contact Lisa Z. Cruz at lcruz@TxBiomed.org

Editor: Lisa Z. Cruz, Director of Public Relations **Design and production:** Ideawire
Photography: Larry Walther

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CAMPUS BRIEFS

Single Cell Genomics transforms malaria research, receives NIH funding

According to the World Health Organization, malaria remains the world's deadliest parasitic disease, killing 627,000 people in 2012, many of whom were children younger than five.

Malaria is contracted through a mosquito bite that injects a small number of parasites into the blood. These parasites work their way to the liver where they multiply and burst into the blood stream.

Until now, scientists did not have the tools or methodology for isolating and genome sequencing an individual malaria parasite cell, which could lead to a better understanding of the disease and development of more effective drug treatments.

Dr. Ian Cheeseman, a post-doctoral scientist in the Department of Genetics, and colleague Shalini Nair have developed a novel method for isolating an individual parasite cell and sequencing its genome. A single malaria infection can contain multiple parasite strains, and each strain within an

"WE'RE NOW ABLE TO LOOK AT MALARIA INFECTIONS WITH INCREDIBLE DETAIL."

infection is genetically distinct. Someone infected with malaria can have multiple types of malaria parasites in them, each affecting the disease progression in different ways.

"It's appropriate to think about these infections as containing the sort of diversity you would see in a human village," Cheeseman said. "We could previously only look at the village as a whole. New technology developed here at Texas Biomed now allows us to identify everyone in the village directly."

These "single cell genomics" approaches have been adopted in cancer research to identify

how tumors evolve during the progression of a disease, but it has been difficult to adapt them to other organisms.

Development of this method, which recently received a four-year, \$1.8 million grant from the NIH and has been supported by the Texas Biomedical Forum and a Cowles Fellowship, is set to change how researchers think about infections.

"One of the major surprises we found when we started looking at individual parasites instead of whole infections was the level of variation in drug resistance genes," Nair said. "The patterns we saw suggested that different parasites within a single malaria infection would react very differently to drug treatment."

Cheeseman added, "We're now able to look at malaria infections with incredible detail. This will help us understand how to best design drugs and vaccines to tackle this major global killer." ■



Animal care takes center stage

Texas Biomed hosted more than 100 members of the Association of Primate Veterinarians on campus for a tour of the Southwest National Primate Research Center (SNPRC) as part of the international Association's annual workshop, which was held in San Antonio in 2014.

The Association, which promotes the "science, medicine, management and humane care of nonhuman primates," is comprised of members from across the globe.

Staff in the Department of Veterinary Resources and Research Support provided attendees insight into the nonhuman primate species housed on campus, as well as the care and feeding, social housing and behavioral enrichment provided to the animals.

"This tour was a unique opportunity to showcase our critical research and the knowledge and expertise of our very capable veterinary and animal care team," said Dr. John Bernal, SNPRC Associate Director of Veterinary Resources. "The team and our primates enable the organization to perform life-changing research for people." ■

Milestone reached in hemorrhagic fever virus study

As researchers worldwide continue to search for ways to combat Ebola virus disease, Texas Biomed researchers have made some critical discoveries in other hemorrhagic fever viruses that have the potential to lead to novel targets for therapies against these pathogens.

Crimean-Congo hemorrhagic fever virus (CCHFV) is a tick-borne virus, which causes a severe hemorrhagic disease in humans and has a fatality rate of 30 to 50 percent.



ABOUT CCHFV:

Name: Crimean-Congo hemorrhagic fever is caused by infection with a tick-borne virus. The disease was first characterized in the Crimea in 1944 and later in 1969 in the Congo.

Symptoms: The onset of CCHFV is sudden, and as it progresses, areas of severe bruising, nosebleeds, and uncontrolled bleeding at injection sites can be seen. Fatality rates are up to 50%.

Scientist in the Department of Virology and Immunology, Dr. Robert Davey, and his team have determined where the virus infiltrates the cell to infect it, revealing the site at which a drug therapy would need to act.

Dr. Olena Shtanko, a postdoctoral scientist in Davey's lab, demonstrated that after passing through early endosomes, which are membrane-bound vesicles within cells, the virus is delivered to multivesicular bodies which are made from large collections of these vesicles. Findings suggested that these multivesicular bodies are critical for infection by CCHFV.

"The next step in the process is to now identify drugs that can prevent interaction of the virus with the multivesicular bodies," Davey said.

Several new drug candidates are presently being tested by Shtanko and showing promising results.

Several other important viruses, including influenza A virus and Lassa fever virus, also use multivesicular bodies to infect cells. The identified drugs have the potential to be developed into broad spectrum antiviral treatments.

The research was funded by the Ewing Halsell Foundation, Douglass Foundation and the U.S. Defense Threat Reduction Agency (DTRA). ■

RESEARCH UPDATE

Research at Texas Biomed against Ebola

As of early November, the latest Ebola virus disease outbreak in West Africa is the largest in history, killing more than 6,000 people, crossing geographic boundaries and capturing international headlines.

Scientists in Texas Biomed's Virology and Immunology Department are sharing their understanding of this deadly disease with the world in interviews with media outlets from Discovery International to the Boston Globe.

Research on Ebola virus at the Institute has been ongoing for 10 years in our Biosafety level 4 containment laboratory, with scientists attacking it from three key flanks: detection, vaccine development and treatment development.

Texas Biomed continues to study the interactions of llama single domain antibodies with the internal Ebola component nucleoprotein. This research is helping develop high-sensitivity detection methods.

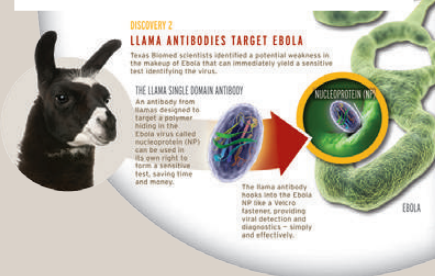
The latest outbreak has accelerated the world's call for a vaccine. Previous work by Texas Biomed scientists in developing a novel nonhuman primate (NHP) model for viruses such as Ebola virus and Marburg virus has aided the efforts of vaccine research, and the team is now involved in developing techniques for the measurement of immune responses in nonhuman primates to a variety of filovirus (Ebola and its cousin Marburg) vaccines. Scientists are also studying viral processes and evolution of the virus in

WORK BY TEXAS BIOMED
SCIENTISTS HAS AIDED
THE EFFORTS *of vaccine
research* AND THE TEAM
IS NOW INVOLVED IN
DEVELOPING TECHNIQUES
FOR *the measurement of
immune responses to a
variety of vaccines.*

order to maximize the understanding of which component of the virus will need to be utilized in vaccine development.

While Ebola virus has no cure, Texas Biomed scientists were involved with showing the utility of repurposing FDA approved drugs for treatment of Ebola virus in rodent models (PloS One: 2013) and have been tapped by the Bill & Melinda Gates Foundation to continue research in this area to better understand the potential of this method beyond the rodent model.

Though the Ebola virus is making headlines today, the Virology and Immunology Department's understanding of this virus has positioned the team well to lead efforts in fighting this deadly disease. ■



Texas Biomed: Years Ahead on Ebola Research

We featured Texas Biomed's research on the deadly Ebola virus in the Fall 2013 issue of Progress — months ahead of the outbreak that is hitting headlines today.

To learn more, visit our website at www.TxBiomed.org and read the **Fall 2013 Progress story, *Texas Biomed Virologists Report Big Gains Against Bioterror Threats***