TMCPULSE

NEWS OF THE TEXAS MEDICAL CENTER — VOLUME 3 / NUMBER 9 — OCTOBER 2016

Bone Deep

How one man,
three institutions
and white-tailed deer
are fighting bone disease

SPOTLIGHT: RENU KHATOR, P. 8 >> TMC MEDICAL DEVICES, P. 20 >> RICE'S DESIGN KITCHEN, P. 30



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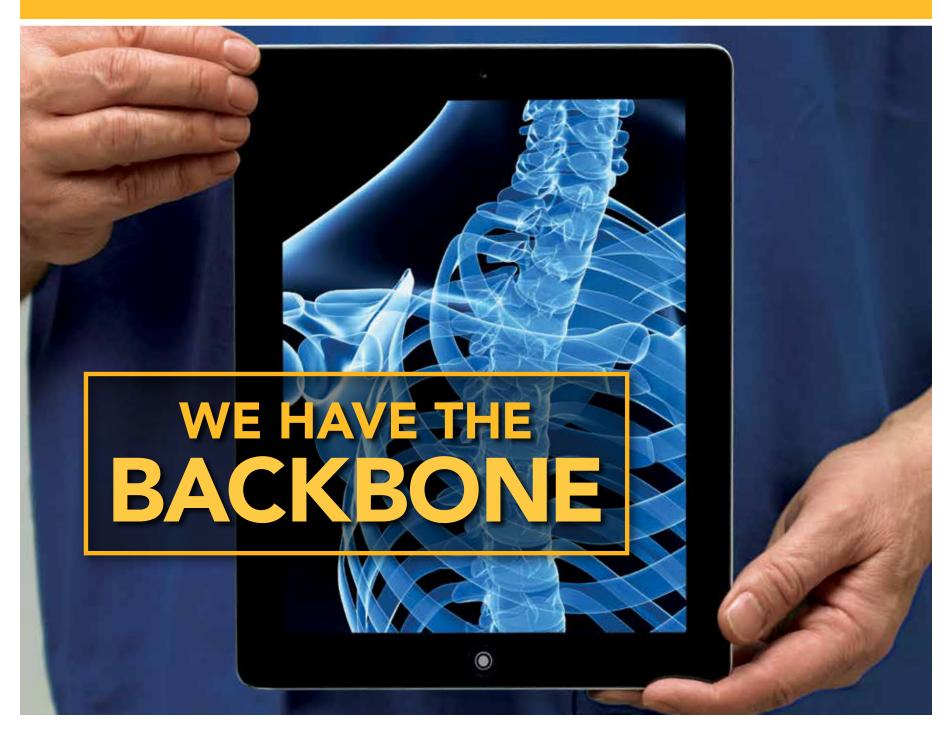
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PRESIDENT'S PERSPECTIVE



ROBERT C. ROBBINS, M.D.

President and

Chief Executive Officer,

Texas Medical Center

When I came to the Texas Medical Center in 2012, the Rolanette and Berdon Lawrence Bone Disease Program of Texas was the only major collaborative effort across the entire campus.

Four years later, that's still true. If there's another such program on a similar scale, I don't know about it.

Founded in 2002, the bone disease program harnesses the research and expertise of The University of Texas MD Anderson Cancer Center, Baylor College of Medicine and The University of Texas Health Science Center at Houston. It is dedicated to finding cures for all types of bone disease.

It's also proof that we can all work together for a common good. And it shows that there must be a good reason—a value proposition—to bring three institutions into one unique partnership. In this case, retired tank barge magnate and philanthropist Berdon Lawrence, who suffers from severe osteoporosis, offered a substantial endowment to a few TMC institutions willing to work together to fight bone disease.

The Broad Institute of MIT and Harvard started in much the same way. Several biomedical research organizations in the Boston area—beyond the two in the institute's name—agreed to work together on genomics. The value proposition there was a man name Eli Broad, who put \$600 million on the table to make it happen. And he lives in LA!

Here at the Texas Medical Center, we have big plans for five institutes that will foster collaboration across all 57 member institutions. Our TMC Innovation Institute and TMC Health Policy Institute have already launched. Still to come: Institutes for clinical research, regenerative medicine and genomics.

But we're just starting.

We can learn from the Rolanette and Berdon Lawrence Bone Disease Program of Texas and from The Broad Institute. Ten years from now, we hope to be just like them

Robert C. Robbins

TMC | PULSE

Vol. 3 No. 8 October 2016

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TMC Pulse is a monthly publication of the Texas Medical Center in Houston, Texas. Permission from the editor is required to reprint any material. Editorial/advertising information is available upon request.

Texas Medical Center News is a member of Houston Press Club, American Medical Writers Association, Association of Healthcare Journalists, and American Advertising Federation.

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Their Best Shot

The making of the annual flu vaccine requires thousands of experts, some hard science and a little guesswork.



Bone Deep

Three TMC institutions are sharing research, technology and finances to fight bone disease.



Patch Work

New hope for spina bifida comes in a patch made from human umbilical cord.



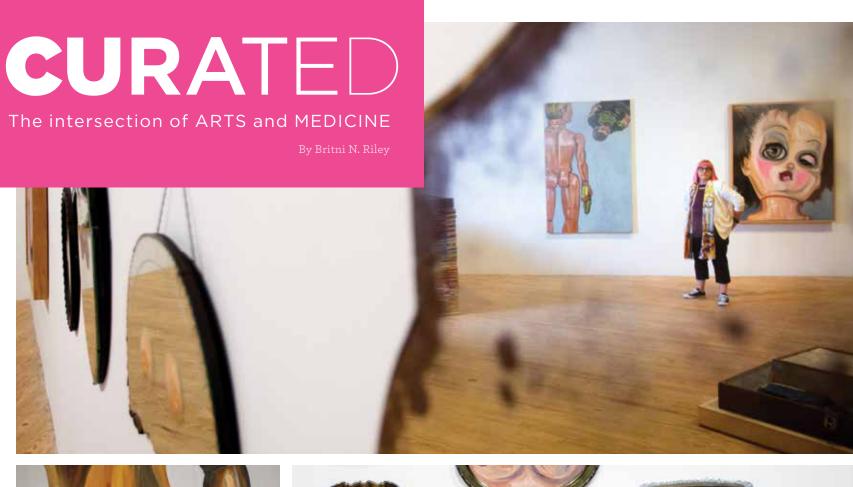
Third Coast

■ A new restaurant opens on the sixth floor of the John P. McGovern Commons. Pictured: Free-range Australian Lamb shank with marble potatoes, baby vegetables and lamb reduction.

ON THE COVER

A white-tailed deer at Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville









Top: Thedra Cullar-Ledford poses in her exhibit at the Contemporary Arts Museum Houston. Bottom left: Paintings are among the mixed media works on display. Bottom right: Trays with painted breasts offer an homage to St. Agatha, the patron saint of breast cancer.

Breasts. Several shapes, sizes and colors are on display in *Lady Part Follies* at the Contemporary Arts Museum Houston. Thedra Cullar-Ledford's mixed media works examine this touchstone of female beauty, leading viewers on her personal journey through anger, vanity and new-found freedom.

In 2013, Cullar-Ledford was ready to donate a kidney to a dear friend when she was diagnosed with breast cancer. Doctors at Houston Methodist Hospital performed a double mastectomy and removed all of the cancer.

It was what happened next that left the artist reeling.

"I was told by my doctors that it was standard for women to receive implants after a double mastectomy," Cullar-Leford said. "So I had it done, but almost immediately I felt like I had a sliver and my body was trying to get the implants out of me." When she voiced these concerns, she was met with resistance—made to feel like she needed therapy.

"It was really hard because I knew that I did not want the implants and it didn't bother me, but it really seemed to bother a lot of other people," Cullar-Ledford said.

Ultimately, she had the implants removed, with support from Barbara Bass, M.D., the head of her care team at Houston Methodist. Cullar-Ledford also found a network of women online who made the same decision.

"During that time, I became more obsessed with boobs than a teenage boy," she said. "I began documenting what was happening with my own body and began documenting what was going on with some of my friends."

Lady Part Follies was the result.Cullar-Ledford's mixed media work features paintings, disfigured dolls (one of the artist's trademarks,) silver trays with painted breasts in an homage to St. Agatha (the patron saint of breast cancer), even a collection of 5,000 trashy novels.

The gallery also houses a giant breast-shaped piñata. Cullar-Ledford invited other women who opted not to reconstruct their breasts after mastectomies to help her smash the piñata and, in so doing, shatter the belief that women need breasts to be beautiful.

"My happiest work is when people who know nothing about contemporary and conceptual art get it," Cullar-Ledford said. "I did this work to help others not have to go through what I went through and to understand that they don't have to reconstruct if they don't want to."

Lady Part Follies will be on display through Nov. 27 at the Contemporary Arts Museum Houston, 5126 Montrose Blvd.; 713-284-8250 or camh.org.

Their Best Shot

How global surveillance, data dumps and chicken eggs lead to a yearly flu vaccine

By Alexandra Becker

ctober marks the beginning of flu season, a harbinger of coughing, aches, fevers, chills and hand sanitizer. Unfortunately, it also means fatalities—as many as 49,000 flu-related deaths each year in the United States.

Individuals with weakened immune systems, and especially the very young and the elderly, are most at risk. But top public health organizations, including the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics, recommend all individuals six months and older receive the flu vaccine to protect against the pervasive virus.

Vaccinations boost the body's defense system by introducing the same infection they are designed to fight. After receiving a vaccination, the body's immune system will produce T-lymphocytes and antibodies, armed and ready to attack the infection it believes to be present. Because nature is so intelligent, the human body will store in its memory these specific antibodies so that if and when it is

exposed to the real virus, it will already be equipped with the necessary tools.

Which raises the question: Why should people get the flu shot each year? Shouldn't our bodies be immune after one vaccination, or after coming down with the flu itself?

Here's the other thing about nature: it evolves. And viruses are no different. Like humans, they are constantly fighting to survive, and while we combat them with vaccines, they evade us through mutation.

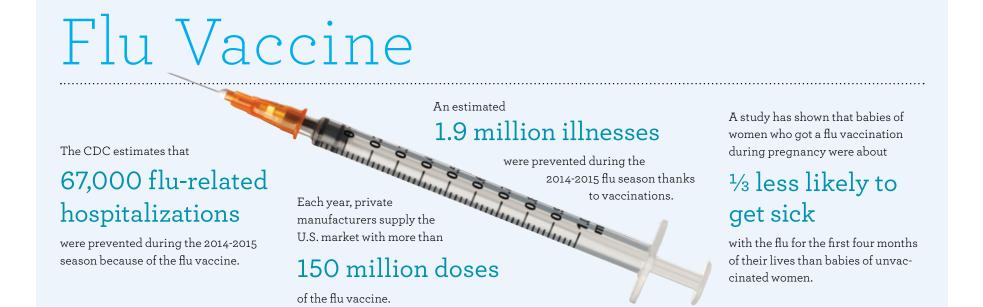
That's why each year, scientists work to create an updated vaccine made up of the top three or four strains of the flu virus, including two influenza A viruses (like H1N1 and H3N2) and at least one influenza B virus. The challenge for experts is predicting which of the thousands of variants will be the most prevalent each year. The decision has to be made months in advance—February for the northern hemisphere and September for the southern—so there is ample time to design and produce the vaccine by peak flu season.



Most flu vaccines are manufactured by using eggs. The seed virus is injected into a fertilized chicken egg, where it can multiply. Credit: Associated Press

"You're always trying to choose the correct strain that is likely to take off. You're doing this with data that has been collected," explained flu expert Pedro Piedra, M.D., a professor in the Department of Pediatrics as well as

Molecular Virology and Microbiology at Baylor College of Medicine. "What we're really looking for is: Are there new viruses? There will always be new viruses, but are there new viruses that are different that we need to worry about?"



Source: The Centers for Disease Control and Prevention

Baylor is one of more than 100 international influenza centers that conducts flu surveillance year-round. The job of these centers is to collect, test and analyze virus samples to help determine which flu strains are making people sick and identify any patterns related to their range and distribution. The centers then send what is called "representative" viruses to five World Health Organization Collaborating Centers for Reference and Research on Influenza. The center for the U.S. is located at the CDC in Atlanta, and the other four are located in London, Melbourne, Tokyo and Beijing.

In February and September, leaders from these centers meet with experts worldwide to review the results of the surveillance and discuss their recommendations for the makeup of the approaching season's vaccine. Based on these recommendations, and with the previous year's vaccine efficacy in mind, it is up to each individual country to decide which strains will be included in its vaccine. The final say for the U.S. lies with the Food and Drug Administration (FDA). Once the decision is made, manufacturing begins immediately.

First, Piedra explained, the FDA supplies "seed viruses" to private sector manufacturers, who are responsible for making all the flu vaccines in the country. The most common manufacturing method occurs through egg-based production, which involves taking the seed virus and injecting it into a fertilized chicken egg where it can multiply. After an incubation period, the virus is harvested and scientists isolate the antigen and package it in the form of the flu shot.

"They are basically very special farms that are highly regulated. The eggs are as clean as they can be," Piedra said. "What you're really trying to do is to grow the virus in eggs in high content, purify it, then inactivate it."

The entire process takes time—six months minimum—and requires a vast number of eggs. It is by far the most prevalent method in practice, but other approaches do exist, including cell-based production, which uses mammalian cells as a vector for replication rather than eggs, as well as a technique involving recombinant DNA technology and the cells of insects.

It's big, important business and, unfortunately, not always on target. In January 2015, the CDC determined that the 2014-2015 season's flu vaccine was only 23 percent effective. As it turns out, a minor strain had become a major player well into vaccine production, and it was too late to do anything about it.

"Many times the prediction is correct, but sometimes the prediction is not," Piedra said. "During the 2014-2015 season, the major circulating virus was H3N2 and it had significantly drifted from the strain in the vaccine. When the decisions were being made as to which components were to be included, the H3N2 variant had just been identified, and that particular variant accounted for about one percent of all H3N2s. Then we saw that it persisted and seemed to be increasing, but at that point we couldn't make it a vaccine component."

Still, Piedra said, it was worth getting the flu shot that season. Although the H3N2 component was not effective, the B component and the H1N1 components worked well. And, while 23 percent efficacy is not ideal, it's also better odds than nothing at all.

That's why, when the CDC's

What you're really trying to do is to grow the virus in eggs in high content, purify it, then inactivate it.

- PEDRO PIEDRA, M.D.

Professor in the Department of Molecular Virology and Microbiology at Baylor College of Medicine

Advisory Committee on Influenza Practices (ACIP) announced that the live attenuated vaccine (commonly known as FluMist) should not be offered this year due to concerns about its effectiveness, Piedra was disappointed. For years, the nasal spray vaccine offered an ideal alternative to the dreaded "shot," increasing vaccination rates among younger children.

"From a pediatrician's perspective, it's sad," he said. "I recently heard someone refer to school children as a biohazard, and it's true. They get infected with everything. They spread it within their units of friendship and acquaintances, and they bring it to the family. Children really are an excellent vector for transmission of influenza."

According to Piedra, the ACIP's recommendations were based on internal data of flu shot effectiveness within certain populations. For the past three years, the live attenuated vaccine had not worked as well as the shot.

"This has brought out a debate, because there are other countries, like our northern borders in Canada, where the live attenuated vaccine has been demonstrated during those same years to be effective. The same thing is true for the U.K.," Piedra said. "So it's unfortunate and we will see what impact it has."

It seems millions of children will need to shut their eyes, hold their breath, and muster some extra courage this year. Experts predict the 2016-2017 flu season will be active, and Piedra urges individuals to take the time to get vaccinated as soon as possible.

"Now is the time to do it," he said.
"Don't wait until flu is here."



Credit: Associated Press



RENU KHATOR, PH.D., is president of the University of Houston and chancellor of the UH System. She speaks with Pulse about her childhood in India, learning English from I Love Lucy, and her quest to turn UH into an academic and athletic powerhouse.

Q Can you tell us about your formative years in India?

A I grew up in a very small town, Farrukhabad, in a family that traditionally has been very conservative.

Q Did you like to study as a child?

A Growing up, I just loved studying and my father always put a lot of emphasis on education. My mother had a huge role; she took great interest in my schoolwork. So I did well in my high school.

Q Did you attend university in India?

A I went to Kanpur University because a campus opened in my hometown that was for girls only. My family didn't want to send me to a coeducational place. I finished my bachelor's degree; I had limited offerings because it was a brand new location, so I studied liberal arts. I won a national scholarship to study further, but the problem was that wherever I would go would be a coeducational place and it would be away from home.

Q Did your family finally relent and let you continue your education elsewhere?

A | Eventually things worked out and my dad did send me to the University of Allahabad, where I always wanted to go because I was interested in political science. This is where political leaders had gone. It was a hub of political activity. At that point I thought I had won the war, but I had only won the battle. Nine months later, my father arranged my marriage to a young man who was studying for a Ph.D. at Purdue University.

And you are still married to this man. Dr. Suresh Khator, now associate dean of the UH Cullen College of Engineering?

A Yes. I met him the same day we were engaged. Ten days later—the time it took to get a passport ready—I traveled with him to Indiana. I was now barely 19 years old. I'm here in the U.S. and I don't know any English. Because I was so distraught, I cried a lot. My husband asked me, 'Why are you so sad?' I told him I wanted an education. He said, 'Well, you've come to the land of opportunity. You can study in the U.S. all you want and I will support you.'

🔾 Is that when you enrolled in a graduate program at Purdue?

A Yes. He took me to school and translated while I spoke Hindi to the graduate advisor. After a lot of talking, the advisor said, 'I'll let you sit in on two classes. No promises. No admission. We'll see where we go.' Once I got my foot in the door, I taught myself English. I watched eight hours of television a day; I know every episode of I Love Lucy. I got two 'A's that semester. I finished my master's degree after one more year.

Q And then you continued on with the Ph.D.?

A | We returned to India after my husband finished his Ph.D. and I finished my master's degree. He was on a government scholarship and was obligated to return to India for five years. We had two daughters there. After five years I said, 'I want to go to a Ph.D. program.' I got admitted back at Purdue, so I started my Ph.D. as a young and new mom. When I finished that, we got an opportunity to go to the University of South Florida. My husband accepted a faculty position there.

Q What was your role at USF?

A They gave me a nine-month appointment as a trailing spouse. But again, once I got my foot in the door, I made my way up. Every two years I had a promotion, either academic or administrative, leading up to provost and vice-president. And then I came to Houston in 2008.

Q | Tell us about your unique role as president of the University of Houston and chancellor of the UH System. You have a reputation here as an astounding turnaround person. You've done so much to transform the university. How did you make it happen in such a short period of time?

A | What I saw in Houston was a tremendous city, not just large in size but large in capacity. I saw a great economy and a public university with top-notch faculty. So to me it was a big puzzle as to why it was not a Tier One university. [The Tier One designation goes to universities known for academic excellence, world-class research, innovation, scholarship and creativity.] For 100 days I had what I called my 'days of solicitation.' We asked everybody-through radio, letters, newspapers—to give me my charge. I told everyone that I was new here and asked them what I should do. I thought there would be 200 to 300 responses, but there were 3,600 comments that came in. That told me people cared.

continued

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Tom DeLay
Politician

Tom Landry
Dallas Cowboys coach

Carl Lewis Athlete

Hakeem Olajuwon Athlete

Jim Parsons Actor

Dennis Quaid Actor

Alice Sebold
Author

Elizabeth Warren Politician

Lil' Wayne Musician

Q | So what did you learn from all the feedback?

A People were frustrated. People said they were stuck, that the university was stuck. So we came back and said, 'We need to elevate this university. How are we going to do it?' Tier One is the pursuit of excellence. We looked at various benchmarks and said, 'We're going to hit this, and this, and keep on moving forward.' What I thought might take five to seven years—that's what I promised my board—took three. It took three years to make the first Tier One list.

Q | And you also hired some distinguished faculty, right?

A I knew we needed to hire more members of the National Academy of Sciences, whose scientists are elected in recognition of their distinguished achievements in original research. I decided I would not sell them the University of Houston; I would sell them Houston. Look at the Texas Medical Center, look at Rice, Baylor College of Medicine. Look at NASA. There are incredible assets here. We needed to sell them the package and

the opportunity to be successful and work with great scientists. In our first six months we recruited our first one, and now we have recruited, of course, many.

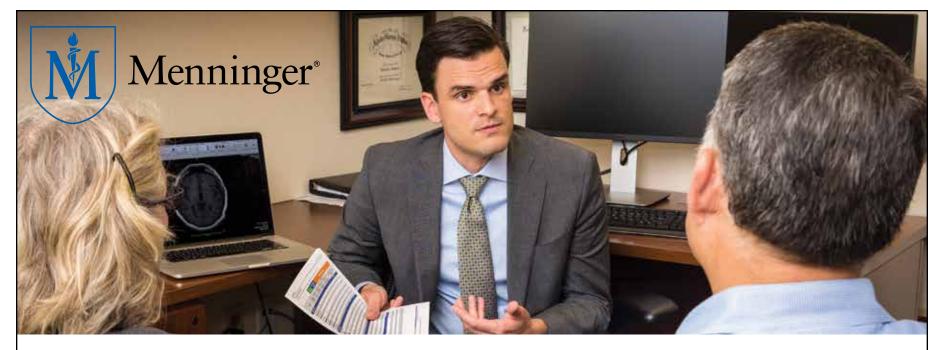
Q Can you share your vision for the future of the University of Houston?

A Our vision is to build a nationally competitive institution, academically and athletically. Academically, we've made huge strides. Our core mission is to make sure our college completion rate beats state and national averages. We also have incredible opportunities in the city for doing synergistic, collaborative research in health, the arts, sustainability, and more. We're looking to build an athletically competitive program, which means we need a nationally competitive stage to show our athletes' talents. I want them to be on national television in front of a national audience as often as possible. And we're also looking at the medical school. There are many communities in Houston that have difficulty getting access to health care. Our primary question is: What can we do to fill that gap?



We have a College of Pharmacy, a College of Optometry, a School of Nursing. We have social work, psychology. Now, what can we do with these assets and 10,000 undergraduate students in this area?

Renu Khator, Ph.D., was interviewed by William F. McKeon, executive vice president and chief strategy and operating officer of the Texas Medical Center.



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ndersson Dyke was born on Dec. 22, 2000, weighing three pounds and 11 ounces. She had her mother's bright blue eyes and a wisp of blonde hair.

Andersson cried and cooed like the other newborns in the

neonatal intensive care unit at Texas Children's Hospital, but there was something different about her. Unlike the other babies, her bones were as fragile as glass.

When Andersson was just a month old, her mother, Sarah, brought her to the pediatrician for a routine checkup. The pediatrician lifted Andersson onto the examination table and began checking her heart, lungs, eyes and ears. Everything looked normal. He held up her legs to check her hips and make sure there were no problems in her joints. And that's when

he felt it: He had broken her femur.

Flummoxed by the sudden and unexpected break, the doctor ordered a magnetic resonance imaging scan to examine Andersson's thighbone. She needed an intravenous line first, but when the nurse fastened the blue tourniquet around her upper arm, Andersson's humerus—the long bone that runs from the shoulder to the elbow—snapped.

"After moving her and doing all of that to get an MRI, she came out with almost all of her long bones broken," Sarah said.

Doctors soon diagnosed Andersson with a unique case of osteogenesis imperfecta (OI), a lifelong disorder more commonly known as brittle bone disease. The condition is caused by a mutation in a gene that affects bone formation and strength. While healthy bones are made of dense living tissue that is constantly being broken down and regrown, Andersson's bones have low density and are prone to fracturing.

In search of answers, the Dyke family turned to a group of doctors in the Texas Medical Center dedicated to studying the full gamut of bone diseases and translating scientific research into bone-saving therapies.

"By understanding and knowing all the different mutations that can affect bones and then developing targeted therapies, we can much more rapidly and more powerfully treat the conditions," said Brendan H. Lee, M.D., Ph.D., Baylor College of Medicine human and molecular geneticist and co-director of the Rolanette and Berdon Lawrence Bone Disease Program of Texas.

The team of doctors who treated Andersson, including Lee, prescribed her bisphosphonate drugs, which are clinically proven to prevent bone loss.

"It worked," Lee said, "but it wasn't a cure."



Sarah and Andersson Dyke, 15, read Missy, a book Andersson wrote about a homeless lion cub who is rescued by a family in Springfield, Ill. Published in 2014, the book is sold through the Osteogenesis Imperfecta Foundation and has helped raise close to \$20,000 to support research, treatment and awareness of brittle bone disease.

Getting married

The Rolanette and Berdon Lawrence Bone Disease Program of Texas began with one man's visit to the doctor nearly 15 years ago.

Retired tank barge magnate and philanthropist Berdon Lawrence met with endocrinologist Robert Gagel, M.D., head of internal medicine at The University of Texas MD Anderson Cancer Center, for a spinal problem his internist noticed on a routine chest X-ray. Lawrence had a long family history of severe osteoporosis, which

occurs when the creation of new bone in the body cannot keep up with the dissolution of old bone. The condition causes porous and brittle bones that can break from even the slightest movements, including sneezing or coughing.

When Lawrence was diagnosed with severe osteoporosis, he was surprised to learn that there was no concerted effort to study bone disease across Texas Medical Center institutions.

By Lawrence's second visit to Gagel's office, the two men agreed that the lack of bone research and treatment in Houston was a serious detriment not only to the growing number of baby boomers entering peak osteoporosis age, but to other patients, like Andersson, who suffer from lesser known bone diseases. Lawrence and Gagel wondered if there was a way to sidestep the competition between TMC institutions and develop, instead, a collaboration.

They approached Baylor College of Medicine, where Gagel had been a faculty member in the division of endocrinology.

Our goal is to take a situation in which people lose bone, and reverse it.

— ROBERT GAGEL, M.D.

Head of Internal Medicine at The University of Texas

MD Anderson Cancer Center

"The Texas Medical Center has the thing that other cities don't have: It's that we're all together," Gagel said. "That's our

strength. We don't need to build strong collaborations within the institutions. We already have them. We just need to work together."

But it wasn't easy. MD Anderson and Baylor each have a wealth of proprietary information, so the legal agreement to work together in one specialized program meant sharing research, technology and finances. This was new territory for both institutions. They essentially had to agree to a pre-nup.

After a year-long legal tug of war and a sizeable endowment from Lawrence, the bone disease program made its official debut in 2002. As the program grew, Lawrence brought The University of Texas Health Science Center at Houston (UTHealth) into the fold in 2014.

"Putting the three of them together is like having 10 institutions," Lawrence said. "I see there's lots of collaboration between all of them now, and I think it will

accelerate the technology and the success in solving a lot of these bone diseases."

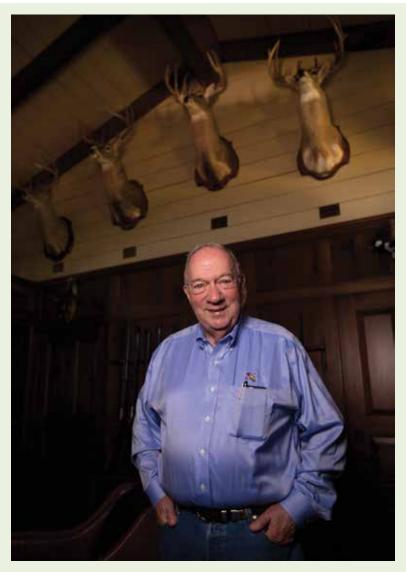
Lauded as the first cross-institutional, multidisciplinary effort of the Texas Medical Center, the program is co-directed by Gagel, Lee, and UTHealth cartilage disorders expert Jacqueline T. Hecht, Ph.D. Its mission: to research and treat a kaleidoscope of "silent killers," including osteoporosis, brittle bone disease, craniofacial disorders and the spread of cancer to the skeleton.

The program has been "a real paradigm for collaboration," Lee said.

"It builds on the strength of all these institutions and puts a legal agreement to get everyone to work together. It was kind of like getting married at some level."

The program operates like the hub of a wheel, Lee explained,

while the spokes represent various activities occurring within Baylor, MD Anderson and UTHealth.



Philanthropist Berdon Lawrence at his South Texas ranch. His personal experience with severe osteoporosis led to the Rolanette and Berdon Lawrence Bone Disease Program of Texas.

With financial and technological support from the three participating institutions, researchers involved in the program have made significant scientific discoveries. Gerard Karsenty, M.D., Ph.D., identified gene RUNX2 as the main protein responsible for bone formation. Benoit de Crombrugghe, M.D., discovered that osteoblasts—the cells that make bone—derive from the same lineage as chondrocytes—the cells found in cartilage. And Lee pinpointed CRTAP as the gene responsible for modulating bone collagen and then identified how mutations within it cause osteogenesis imperfecta.

"When we bring all of the patients and all of the institutions together as part of the program," Lee said, "we are now actually elucidating at a very refined level the function of all the things that control bone health. That's been the enormous achievement."

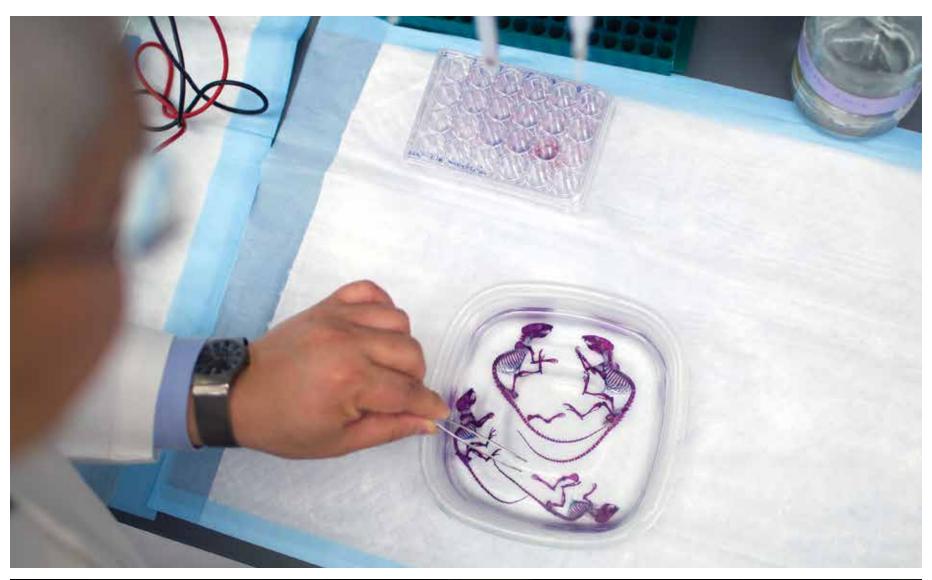
Hecht added: "We all have expertise in different

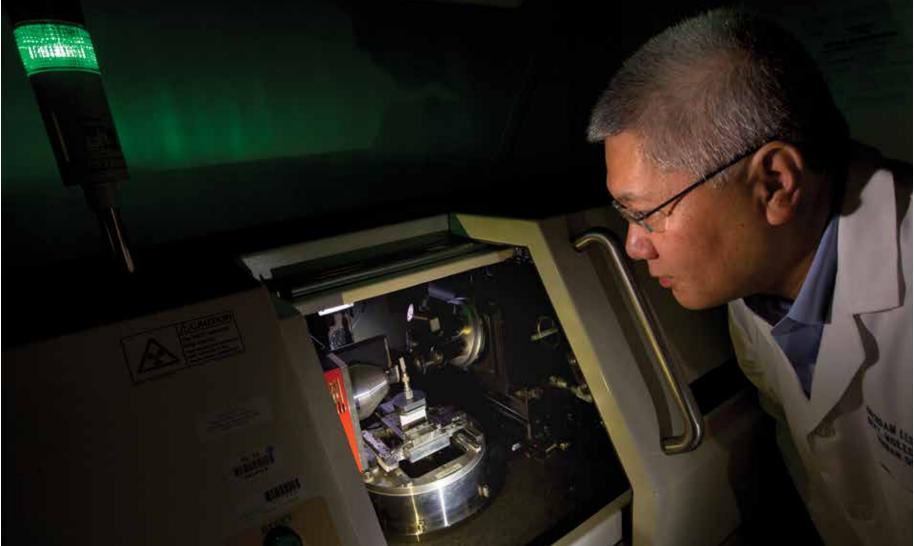
areas. By putting us together, we are stronger as a group than we are individually."

A little earthquake

Andersson Dyke's spine follows an S-shaped curve that limits the space in her chest and weakens her lungs. Without her walker or wheelchair, she can only amble around a short distance before she runs out of breath and her bones begin to ache.

At a young age, she endured an extensive surgery in which doctors placed metal rods in her arms and legs to splint her long bones. But her bones still break. They've broken "up to a 100" times in Andersson's 15 years, her mother said, though it's hard to keep track because of how frequently it happens.





Top: Brendan Lee, M.D., Ph.D., chairman of molecular and human genetics at Baylor College of Medicine and co-director of the Rolanette and Berdon Lawrence Bone Disease Program of Texas, examines mice skeletons specially stained to show bone in red and cartilage in blue. Double-staining the skeleton allows researchers to better identify any abnormalities in the structure and pattern. Bottom: Lee uses the phase contrast-microCT scanner to produce ultra-high resolution images of bones and cartilage.

"When she was a baby, she would break a bone about once a week," Sarah said. "It's still physically and emotionally painful."

But with the bisphosphonate treatments, Andersson's frac-

tures have become less frequent, giving her the chance to lead a more ambulatory and independent life.

Between 20,000 and 50,000 cases of osteogenesis imperfecta exist in the United States, according to estimates from the National Institutes of Health. With more than 800 different mutations currently known to cause OI, biochemical and DNA testing can often help patients and doctors identify the type and severity of the disease, as well as potential therapies.

Because Andersson did not exhibit the typical forms of the disease, she confounded doctors, who were unable to genetically determine her condition. Ultimately, she was clinically diagnosed with type 3 OI, considered the most severe of the eight known types of brittle bone disease in children who live past their first few months.

Eventually, Andersson adapted to her constantly fracturing bones and learned to become ambidextrous amid a never-ending cycle of pain and necessity. When she broke her left arm, she'd use her right arm to write, eat, draw and perform other

activities. When the right arm broke, she'd switch back to the left and start the process all over again.

When she was a baby, she would break a bone about once a week. It's still physically and emotionally painful.

— SARAH DYKE

Mother of Andersson Dyke

"People think I'm crazy because we wouldn't go to the doctor every single time," Sarah said. "We would be there all the time." It's true. Given the rarity of Andersson's condition, most

doctors would waste time scratching their heads, while Andersson already knew the protocol: Wrap the site of the fracture to support it without completely immobilizing it, get comfortable on the living room sofa, turn on the television to Nickelodeon, and try not to move until the fracture becomes less painful.

It usually takes
Andersson's body a week or
two to heal from a hairline
fracture. But when a bone
breaks all the way through,
it can take up to two months
to heal.

"I know my body really well," Andersson said. "Every time I break a bone, I can accurately tell what happened to it. If it's just a pop, then I know it's a little pop. But if it's a break, then I can hear the bones."

This March, Andersson was walking around her house when she suddenly felt an excruciatingly sharp, cracking pain in her leg, like "a little earthquake in my bones," she said.

Her femur had snapped, out of the blue. The metal rod was the only thing keeping her leg straight.

"The hardest part about

OI is that you never know when it's going to happen," Sarah said.

There are currently six classes of drugs—including bisphosphonates that block osteoclasts from dissolving bone—and at least three new therapies pending Food and Drug Administration approval designed to treat bone loss. But there is still more to be done for patients.

"Our goal is to take a situation in which people lose bone, and reverse it," Gagel said. "We have gotten reasonably good at that."

While there is currently no cure for OI, osteoporosis and many other bone diseases, doctors at the Rolanette and Berdon Lawrence Bone Disease Program of Texas see new hope on the horizon—for Andersson and millions of others—in the antlers of white-tailed deer.





Top: Robert Gagel, M.D., head of internal medicine at The University of Texas MD Anderson Cancer Center and co-director of the Rolanette and Berdon Lawrence Bone Disease Program of Texas, explains how a healthy bone and osteoporotic bone appear the same on the outside.

Bottom: Bone models show the density in a healthy bone (left), and an osteoporotic bone (right).

Antlers

"Berdon, I'd like you to bring me a deer antler home," Lee told Lawrence on the phone about two years ago. Lawrence, who owns a 14,000-acre ranch in South Texas, knows a thing or two about deer. But what Lee wanted with an antler was a puzzler.

"Okay, well, I can do that," Lawrence responded. "But what do you need a deer antler for? You want something mounted to put in your house?"

No, Lee didn't want a rack to hang above his mantel. Instead, he wanted to analyze the antler as part of a new study for the bone disease program. Deer antlers have fascinated those in the bone field for a long time because bucks are able to grow them back every year, in pattern, over three or four months. Additionally, deer antlers share many properties with human bone and serve as excellent models for bone growth in humans.

"It's the fastest regenerating organ in the animal world," Lee said. "We thought, 'Wow, wouldn't it be amazing to understand how that works?""

Lawrence never did bring Lee a deer antler. Instead, Lawrence took him to the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville on King Ranch, where he was able to collect blood samples from white-tailed deer for his research. Lee and his team became the first to sequence the white-tailed deer's genome, a sequence with more than three billion nucleotides. The process took nine months.

Lee believes analyzing the complete deer genome will open a whole new frontier in bone disease research. Understanding which genes regulate antler growth and provide blueprints for their structure could lead to novel bone regeneration therapies to help patients with a range of bone diseases—everyone from 15-year-old Andersson Dyke to 74-year-old Berdon Lawrence.



Jacqueline T. Hecht, Ph.D., associate dean for research at the UTHealth School of Dentistry, joined the Rolanette and Berdon Lawrence Bone Disease Program of Texas as a co-director in 2014.

BONES

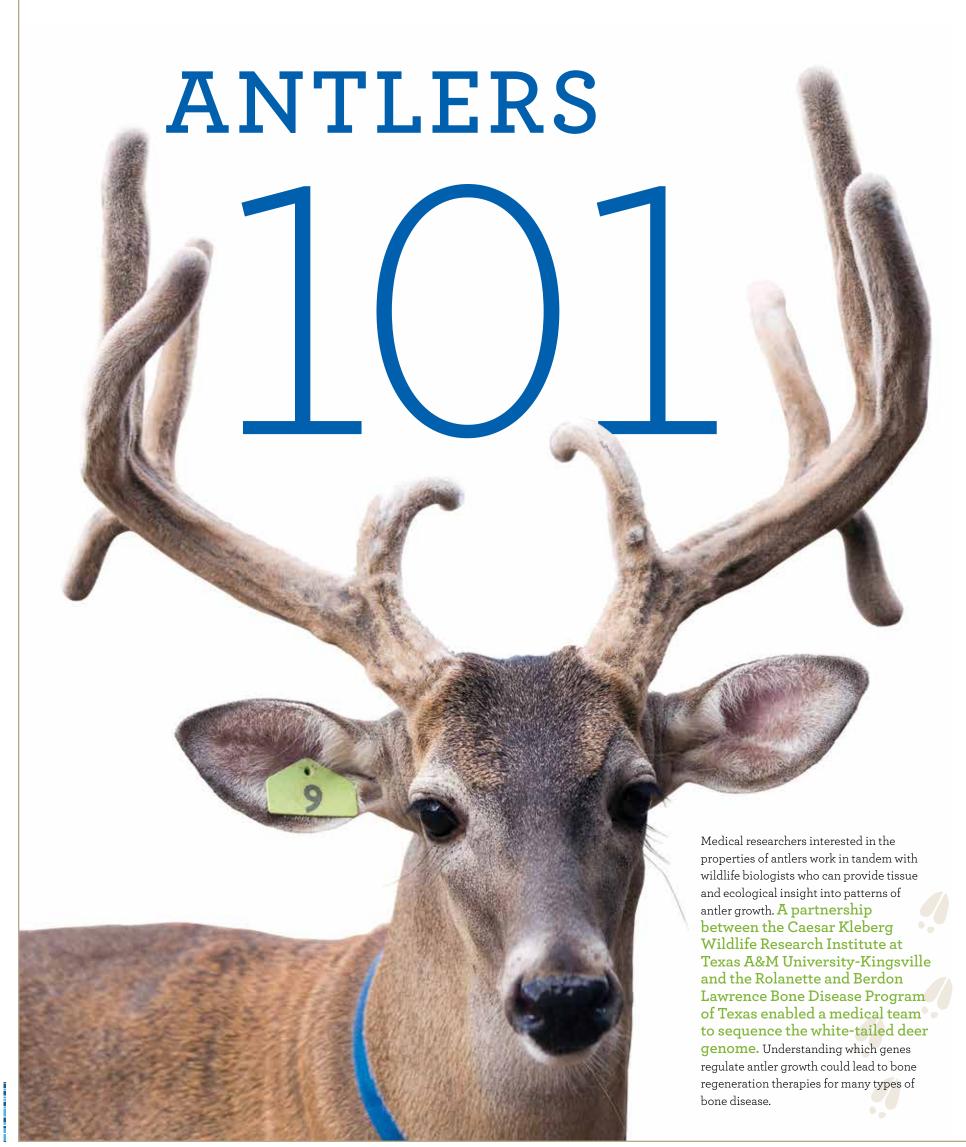
In literature and the arts, the human skeleton is often a memento mori associated with the macabre and death. But bones give us life.

Bones provide our bodies with shape, support and movement, while protecting our vital organs from external damage. Bone marrow contains stem cells that develop important oxygen-carrying red blood cells and infection-fighting white blood cells. Bones also release osteocalcin, a protein that helps regulate the body's blood sugar and fat, and store essential minerals.

Bones are primarily made up of three components:

Type 1 collagen, the same type of molecule found in the skin; calcium phosphate; and calcium carbonate. The collagen is a long protein that weaves together with two other strands of collagen to create a flexible rope-like structure with grooves along the sides. Crystals of calcium phosphate and calcium carbonate attach within these grooves to provide rigidity and strength.

When a bone fractures, blood clots around the site of the break and specialized immune cells, called phagocytes, devour bacteria, foreign particles and dead cells to protect the bone from infection. Cartilage cells, called chondroblasts, then produce the collagen matrix around the fracture to connect the bones, allowing osteoblasts—cells that synthesize bones— to begin calcifying and building new bone.





Antlers are found only on members of the Cervidae family, which is made up of deer species. In North America, that species includes white-tailed and mule deer, brocket deer, elk, moose, and caribou.



Archaeological evidence shows that antlers have been important to civilization for thousands of years for utilitarian, religious, aesthetic, sporting and medicinal purposes.

The use of antlers in medicine is often associated with Asian culture. One record of deer antler use was found in a Chinese text that dates back nearly 2,000 years. Today, deer antler velvet—the tissue covering the bone and cartilage that become antlers—is sold in slices or powders and made into a medicinal soup.



Producers of deer antler sprays, which are generally considered to be dietary supplements, say the active ingredient in the spray is insulin-like growth factor 1, or IGF-1, a naturally-occurring hormone that promotes growth. IGF-1 is banned by the U.S. Food and Drug Administration and the World Anti-Doping Agency, as it is a proven performance enhancer when taken in certain forms.

Deer antler research also benefits wildlife ecology and management. A better understanding of the genetic basis of antler growth will offer insight into the vast amount of variation in antler traits among deer species, among different deer within the same species, and within an individual deer from one year to the next.



 $Source: Caesar\ Kleberg\ Wildlife\ Research\ Institute$



Tinkering with the Future

Health problem? A medical device might fix it.

By Christine Hall

Albert Huang, M.D., founder and CEO of Allotrope Medical, was a general surgery resident at Houston Methodist Hospital when he realized he had a great idea for a medical device.

Huang often assisted on sigmoid colon resection, a surgery to remove part of the colon affected by conditions including diverticulitis—an inflammation of the colon. "As I would work with the more senior surgeons, there would be certain aspects of the operation that were often time-consuming," said Huang, a member of the Texas Medical Center Innovation Institute's first TMCx

accelerator medical

device class.

A critical step of a sigmoid colon resection is locating the ureter, a tube that carries urine from the kidney to the bladder, to make sure it is not harmed during surgery. Damage to the ureter is not uncommon and can lead to problems including urine leaks (a hole in the ureter), abscesses (swollen areas where pus collects), a loss of kidney function or even death.

"We did one resection where there was a lot of scarring, and we probably spent 30 percent of the time trying to identify the ureter before we could even start the surgery," Huang said.

Surgeons typically do one of
two things to locate the ureter
before surgery: Have a
urologist find it and place
a stent in it, or search
for it themselves via
tissue dissection.

While considering different ways to simplify this process, Huang took inspiration from a method anesthesiologists use to make facial nerve muscles twitch via low-current electricity. He built a hand-held device that sends a short pulse of current down the tip of the device with the push of a button. The current causes the ureter to contract; that way, surgeons know where it is and can avoid harming it.

Huang hopes the TMCx accelerator class will help him refine the device and capture the attention of doctors interested in trying it.

Building prototypes

Over the years, many Texas Medical Center doctors, researchers and personnel have helped design or implant medical devices considered state-ofthe-art for their time.

In 1966, the late Michael E. DeBakey was the first to successfully implant a left ventricular assist device (LVAD), which pumps blood to the body after the heart has failed. DeBakey worked at Baylor College of Medicine, directed the Houston Methodist DeBakey Heart & Vascular Center and was senior attending surgeon at Houston Methodist Hospital. He and colleagues developed the DeBakey Ventricular Assist Device; DeBakey believed that

two of these working together could function as a total heart replacement.

Denton Cooley, M.D., once DeBakey's protégé and then a cardiologist with the Texas Heart Institute, was the first to implant a total artificial heart into a patient in 1969.

If doctors DeBakey and Cooley are considered the James Bonds of medicine, Juan Fernandez would be the medical device equivalent of "Q." He was working in the machine shop at Baylor College of Medicine when asked to help DeBakey prototype an early version of the LVAD. The prototype was a small, plastic device that featured an impeller, a fan-like rotor operated by magnets. Today's versions have a titanium impeller.

Now lead machinist at the Houston Methodist Machine Shop, Fernandez is proud to show off the prototype, which he keeps in the drawer of an old tool chest.

Fernandez's father died of a heart attack when he was young.

"I take pleasure in knowing that I have helped people, though I wish I could have helped my dad,"

MEDICAL DEVICES OF THE TMC

CHI St. Luke's Health

In 1996, Zvonimir Krajcer, M.D., repaired an abdominal aortic aneurysm by inserting a stent graft into the aneurysm through small incisions in the groin. To execute this new technique, Krajcer, now program director of peripheral vascular interventions at the Texas Heart Institute and Baylor St. Luke's Medical Center, designed a tiny graft, 4.7 millimeters in diameter, to help seal off and repair the aneurysm.

Memorial Hermann-Texas Medical Center

The Kim-Dannenbaum-Shin Microsurgical Robotics Laboratory is developing robotic devices for procedures to treat cerebral stokes and other brain abnormalities. The devices can navigate small, narrow and branched blood vessels in the brain to reach sites deep in the body.

 $Denton\ A.\ Cooley,\ M.D.,\ holding\ a\ Bi\ VACOR\ total\ artificial\ heart.\ Credit:\ Terry\ Vine\ Photography$



Juan Fernandez, lead machinist for Houston Methodist Hospital, working in his shop. Below right: Fernandez holds a prototype of an early version of a left ventricular assist device (LVAD) that he worked on with famed surgeon Michael E. DeBakey, M.D.

Fernandez is still helping people with his prototypes. He is in the early stages of a project with the Texas Heart Institute and BiVACOR, a Houston company headquartered at the institute, making impellers for a total heart that pumps blood through the body without a pulse.

A smaller heart

Iki Adachi, M.D., a congenital heart surgeon at Texas Children's Hospital,

is working on a miniaturized implantable ventricular assist device specifically designed for small children. Called the Infant Jarvik VAD, it is named for Robert Jarvik, M.D., inventor of the first successful total artificial heart.

With support from the federal government through the National Heart, Lung and Blood Institute, this AA-battery-size device has undergone pre-clinical testing; Adachi anticipates approval for a human trial sometime this year.

In the pediatric world, most of the ventricular assist devices are pulsatile, meaning they pump like the heart. But they can fail, which is why most adult VADs are now continuous flow devices—pumps that help push blood through the body using an impeller, Adachi said. Currently there aren't pediatric continuous flow devices available. Texas Children's hopes to change that.

"It is more challenging to make a smaller pump with a favorable performance," Adachi said. "As such, the U.S. government has been trying to help companies that have an interest in pediatric devices. They have funded several different companies, and Jarvik is one of them."

Jarvik tried to get FDA approval for a clinical trial two years ago, but failed, Adachi said. After significant design changes, Adachi came on board to implant the device in animals. He wasn't part of the first trial, but said the data collected seems to be much more favorable than the previous testing. A new application for clinical trial was completed in September. If approved, the Pumps for Kids, Infants and Neonates (PumpKIN) trial is likely to begin by the end of the year.

Texas Children's implants about 20 to 30 VADs per year, Adachi said.

"If the Jarvik pump becomes available, that may change our device support paradigm, and we may have more potential candidates," he said. "Now we have limited options on what kind of patient we can support."



Rice University

Rice University bioengineering students created a low-cost neonatal breathing system as part of the Rice 360° Institute for Global Health. A study of the bubble Continuous Positive Airway Pressure (bCPAP) device showed it could save the lives of 178,000 low-birth-weight babies in Africa each year.

University of Houston

Jarek Wosik, a principal investigator at the Texas Center for Superconductivity at the University of Houston, has developed a high-temperature superconducting coil that allows magnetic resonance imaging (MRI) scanners to produce higher resolution images in a shorter period of time.

The University of Texas Health Science Center at Houston

Steve Norris, Ph.D., vice chair for research in the Department of Pathology and Laboratory Medicine at UTHealth, developed a diagnostic test to positively identify patients suffering from Lyme disease. He collaborated with Alan Barbour, Ph.D.

Credit: Tommy LaVergne/Rice University

A Man of the World

Robert C. Robbins, M.D., wins 2016 International Citizen of the Year Award

By Shanley Chien

n a warm September evening, guests from across the city gathered at the Hilton Americas Hotel to honor Robert C. Robbins, M.D., president and CEO of the Texas Medical Center.

Robbins was named International Citizen of the Year at the World Affairs Council of Greater Houston's annual Jesse H. Jones Award Gala. While the TMC Orchestra performed the Star Wars soundtrack in his honor, several members of the local business community spoke to his influence.

"Less than four years ago, we all found out that this fancy genius California doctor was coming to run the most sacred of Houston institutions, the Texas Medical Center," said Paul Hobby, chairman of the Greater Houston Partnership. "We're all on the edge of our seats to see what he can do next because what he's done in four years is simply astounding."

Each year, the council selects an influential leader who has made a significant contribution to Houston and beyond, by exhibiting the same passion and vision as Jesse H. Jones—a politician, entrepreneur and philanthropist who helped lead Houston and the country through the Great Depression and World War II.

"Jesse H. Jones was visionary in his recognition that the city's future depended on our international engagement," said Sandija Bayot, interim executive director of the council. "Dr. Robbins' vision and tireless efforts to attract biotechnology leaders, investors and other stakeholders from around the world to innovate and partner with TMC institutions embody the spirit of the International Citizen of the Year Award."

Robbins has elevated Houston's global profile by courting partnerships with China, India and Australia.



The Texas Medical Center Orchestra performed the Star Wars soundtrack at the gala. Musical director and conductor Libi Lebel conducted with a light saber.



Texas Medical Center president and CEO Robert C. Robbins, M.D., delivers his acceptance speech for the World Affairs Council of Greater Houston's 2016 International Citizen of the Year Award.

An internationally recognized cardiothoracic surgeon, Robbins joined the TMC in 2012 to increase cross-institutional collaboration and research initiatives around medical innovation, genomics, regenerative medicine, clinical research and health policy. Robbins has created a culture keen on breaking down silos and building on creativity and teamwork. Already this year, the Texas Medical Center has partnered with AT&T for its sixth Foundry for Connected Health, and opened Johnson & Johnson's JLABS @ TMC.

Meanwhile, Robbins is ramping up efforts to expand the medical center. In the works is the TMC³ Translational Research Campus, which will integrate academic research and clinical partners.

His goal, he said, is to streamline the bench-to-bedside process across the medical center and develop new drugs, new medical devices, new diagnostics and new digital platforms with the sole purpose of improving the health of humanity.

"In the last four years, I think we're involved in something that even Jesse Jones and Mary Gibbs Jones, Monroe D. Anderson and George Hermann would be proud of," Robbins said. "This is probably the most exciting life sciences project going on in the world today. We're pretty excited about the work we're doing."

Hobby attributed Robbins' success in leading a "quiet revolution" at the Texas Medical Center to his genial yet direct nature.

Robbins "has taken that sacred institution in the most graceful way," he said. "He has pivoted it in a way that has excited the whole city, that is unquestionably the right direction for the city and the medical center."

Previous recipients of the award include numerous oil, gas and energy executives, including ConocoPhillips chairman and CEO Ryan Lance, EnerVest CEO John B. Walker, former Baker Hughes CEO Chad Deaton and former Houston Lighting and Power chairman and CEO Don Jordan. The decision to honor Robbins is a testament to the growing number of major industries that are helping to diversify and globalize the Houston economy.

"As a global city, Houston is blessed to have leading industry sectors like energy, aerospace and medicine operating and thriving here," Bayot said. "We are doubly blessed to have leaders like Dr. Robbins who call Houston home, and not only serve as global ambassadors for institutions like the Texas Medical Center, but the region as a whole."

Solutions

TMC innovations

By Christine Hall

A fter returning from her honeymoon in Costa Rica, Diana Clayton began to experience cramps and diarrhea, a possible side effect of drinking contaminated water. Or so she thought.

But her symptoms got so bad that she ended up in the hospital, where a CAT scan revealed she had a severely inflamed colon that was near bursting, the result of an intestinal bacterium known as Clostridium difficile (C.diff). She thought the initial hospital visit had cured the problem, but repeated C.diff infections followed. Clayton couldn't stop losing weight; she got down to 87 pounds and ultimately had to quit her job as a radiation therapist.

"I was so sick," Clayton said. "I couldn't think straight anymore. I was walking sideways, calling things the wrong color."

C.diff., an infection often contracted while receiving medical treatment in a health care facility, affected an estimated half million people in the United States in 2011, according to the most recent data available. Worse yet, 29,000 people died within 30 days of the initial diagnosis, according to the Centers for Disease Control and Prevention.

As the bacterium's name suggests, it is difficult to treat C.diff, but researchers at UTHealth School of Public Health's Center for Infectious Diseases and the Kelsey Research Foundation are working on an innovative procedure that has seen early success.

Herbert DuPont, M.D., professor and director of the Center for Infectious Diseases, and Zhi-Dong Jiang, M.D., Dr.PH, an associate professor at the center, created a treatment that extracts bacteria from the human stool of a healthy patient and turns it into a pill. Known as a fecal microbial transplant (FMT), this treatment crowds out the bad bacteria in the gut and replaces it with good bacteria.

To create the pill, DuPont used a



Zhi-Dong Jiang, M.D., Dr.PH, an associate professor at the Center for Infectious Diseases, and, Herbert DuPont, M.D., professor and director of the center, created a treatment that extracts bacteria from the human stool of a healthy patient and turns it into a pill. Credit: Terry Vine Photography

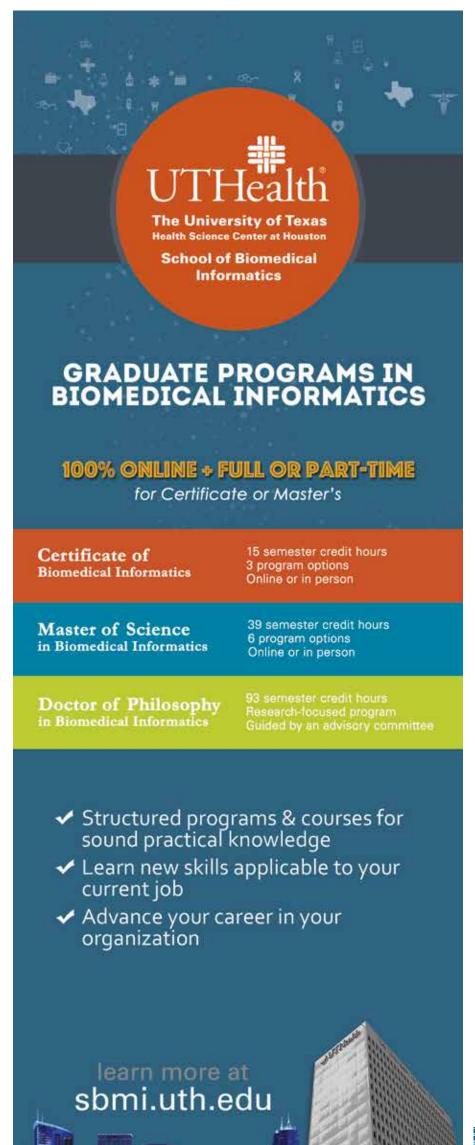
lyophilizing machine, which freezes and pressurizes stool samples to remove all moisture—similar to the process of making freeze-dried coffee. A Houston-area compounding pharmacy inserts the final, purified product into the 20 or 30 capsules that are used in one treatment dose. Typically, patients get two treatments, one at the research site via colonoscopy and another at home. A coating on the pill masks the odor.

DuPont and Jiang started a clinical trial of FMT in 2013, using stool samples from colonoscopy patients at CHI St. Luke's Health-Baylor St. Luke's Medical Center, a partner in the study. The treatment yielded a 90 percent success rate. One of those success stories was Diana Clayton.

Clayton had two fecal microbial transplants, one through a colonoscopy and the other by taking 30 capsules of the healthy stool. After a week, her energy and appetite returned.

"I started to have food cravings, and I hadn't had a food craving in months," she said.

The doctors are now carrying out additional studies with FMT delivery by a single enema or by administration of only five capsules.







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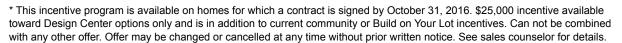


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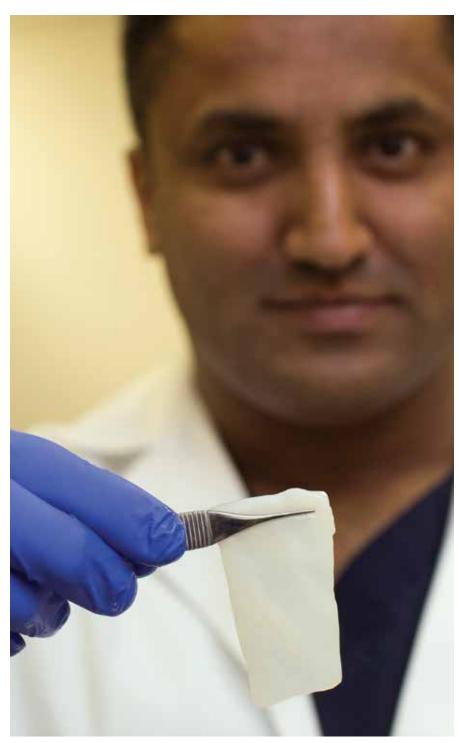




Patch Work

New hope for spina bifida's youngest patients

By Alexandra Becker



Ramesha Papanna, M.D., M.P.H., an assistant professor in the Department of Obstetrics, Gynecology and Reproductive Sciences at McGovern Medical School at The University of Texas Health Science Center at Houston and a maternal-fetal medicine specialist at The Fetal Center at Children's Memorial Hermann Hospital, holds a patch made from human umbilical cord.

Seven years ago, Lovepreet K. Mann was standing at a crosswalk in Salt Lake City with her husband and colleague, Dr. Ramesha Papanna. They had been testing an underwater glue for fetal surgery, and a thought suddenly occurred to her. There, on the street in Utah, the couple began a discussion that would ultimately lead to a patch made from human umbilical cord. Today, it is being used to help repair spina bifida in babies before they're even born.

A "super C-section"

Spina bifida is a birth defect characterized by an incomplete closing of the bones and membranes surrounding the spinal cord. In most cases, tissues and nerves are exposed in an opening along several vertebrae in the baby's back, making him or her highly susceptible to life-threatening infections and sometimes triggering complete paralysis of the legs as well as bladder incontinence and a range of cognitive difficulties. The condition is typically detected in a pregnant woman's 20-week anatomy scan, during which time the ultrasound tech identifies either a lemon-shaped head or a "banana sign," both caused by pulls in the cranial area from the spinal malformation.

For decades, the standard treatment has included postnatal surgery, but sentiments shifted after the ground-breaking NIH-funded MOMS Trial (Management of Myelomeningocele Study) initiated in 2003, in which standard repair results were benchmarked against more than 90 fetal repair cases. The results spoke volumes. Babies who underwent fetal repair were much less likely to need a ventricular shunt for hydrocephalus. Furthermore, twice as many children from the fetal surgery

Every day you could watch the blood vessels and the tissues grow closer together. It was incredible.

- RAMESHA PAPANNA, M.D., M.P.H.

group were able to walk without crutches at 30 months of age, compared to those who received the surgery after birth.

Not all patients qualify for the highly specialized, extremely complex procedure, which involves either pulling the skin together or stitching a patch directly onto the spina bifida site of the fetus while it is still in the mother's womb. Likened to a "super C-section," the intricate series of surgical steps (making an incision in the mother, protecting the placenta, opening up the amniotic sac, preserving the fluid, performing the repair through a tiny three-inch by four-inch window in the uterus, replacing the fluid, closing the uterus and then the mother layer by layer) is also not without risk. Most babies who undergo fetal surgery will be born prematurely. There is potential for post-surgical complications and infections. There is the risk of death. And, until Mann, a research instructor in the Department of Obstetrics, Gynecology and Reproductive Sciences at McGovern Medical School, thought of using the regenerative material she and Papanna had been studying to patch the site, there was the likely possibility of scar tissue formation, which meant further injury to the spinal cord as the child grew and developed.

Originally, Papanna, the principal investigator and an assistant professor in the Department of Obstetrics, Gynecology and Reproductive Sciences at McGovern Medical School at The University of Texas Health Science Center at Houston and a maternal-fetal medicine specialist at The Fetal Center at Children's Memorial Hermann Hospital, was interested in using amniotic membrane from the placenta to seal fetal membranes—the layers of the amniotic sac—after surgeries in utero. He and Mann flew to Miami to meet with expert ophthalmologist Scheffer C.G. Tseng, M.D., Ph.D., who was using a human amniotic membrane patch to repair corneas. After spending a week in his center, the two were even more impressed at its regenerative properties.

What makes the material so "magical," as Papanna puts it, is a compound called heavy chain hyaluronic acid/pentraxin3, which initiates natural regeneration of the tissues at the repair site, rather than healing by scar formation. The distinction is important in spina bifida repair since one creates a healthy, biologically compatible environment

while the other often leads to scarring of the spinal cord to the repair site. This can lead to loss of bladder and motor function later in life. If scarring occurs, further surgeries are required to remove the scar tissue and protect the spine.

"The molecule is the same one that is present around the egg of every woman who ovulates every month, in the lining of the womb and the placenta. This is essential to maintain normal reproductive function," Papanna said. "Nature has created a solution, and we have harnessed it to our benefit."

But this wasn't the fairytale ending Papanna and Mann had hoped for. Despite its phenomenal healing properties, the amniotic membrane patch was paper-thin and flimsy, making it difficult to work with.

"If the site gets infected, the baby dies," explained Kenneth Moise, M.D., director of the Fetal Intervention Fellowship Program at McGovern Medical School and co-director of The Fetal Center at Children's Memorial Hermann Hospital. "It's covering the spinal cord, so it has to be a watertight seal—CSF [cerebrospinal fluid] can't

leak out and infections can't come in."

Unfortunately, every time Papanna practiced his stitches on the delicate material, it tore. So he looked to the umbilical cord, which contains the same "magical" molecules as the amniotic membrane, but is thicker and far more pliable.

"It was so obvious," Papanna said.
"The umbilical cord has the same regenerative properties."

Success stories

Mann and Papanna contacted Tseng, who created a new patch and sent it back to them for testing. After suturing multiple chicken breasts and injecting blue dye as a proxy for cerebral spinal fluid, Papanna and Mann were satisfied that it could provide the watertight seal necessary for spina bifida repair. Papanna's lab studied its performance in animal models and he was granted approval from the FDA for clinical use in three cases. He and a team of surgeons including Moise, Kuojen Tsao, M.D., co-director of the Fetal Center at Children's Memorial Hermann Hospital and an associate

professor at McGovern Medical School's Department of Pediatric Surgery, and pediatric neurosurgeon Stephen Fletcher, D.O., an associate professor in McGovern Medical School's Department of Pediatric Surgery, performed the first surgery in July 2015. A second case was performed a few months later, and the results of the two surgeries were published in Obstetrics and Gynecology in July of this year.

So far, they have been success stories. In both cases, the surgeries went well and the babies were born at 37 and a half weeks, just three weeks shy of full term. At birth, the patch was still in place and there were no signs of leakage or fluid inside. Moreover, both babies retained lower limb function as well as normal bowel movements. The one peculiarity was that, at birth, the site had not yet regenerated—it was semi-translucent, and when Papanna tapped the baby's head, he could see the cerebrospinal fluid underneath the patch. Within a few weeks, however, the skin grew into the patch exactly as expected.

"Every day you could watch the blood vessels and the tissues grow closer together," Papanna said. "It was incredible."

A third case was completed and as the months pass, all three babies continue to exhibit normal leg movement and bladder control and no need for further repair. The true test will come with time, but already the patch is showing promise as the next big advancement in fetal surgery: whereas the MOMS Trial demonstrated that fetal surgery could vastly improve outcomes in mobility and neurological development, this patch could take the procedure a step further, resulting in an even more improved outcome for children with spina bifida. Perhaps, in the future, there will be no more need for surgical revisions, no additional repairs, few if any symptoms. An entirely normal childhood.

"People are trying stem cells and different 'off the shelf' patches, but this patch is doing more than any of the others," Mann said. "It's helping with regeneration of existing skin. It's creating organized growth of tissues, and the body doesn't reject it. Even more, its source is abundant since the umbilical cord from every pregnancy could produce a new patch."



From left to right, Ramesha Papanna, M.D., M.P.H.; Lovepreet K. Mann, M.B.B.S.; Stephen Fletcher, D.O., associate professor in McGovern Medical School's Department of Pediatric Surgery and pediatric neurosurgeon affiliated with Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center and Children's Memorial Hermann Hospital; and Kenneth Moise, M.D., director of the Fetal Intervention Fellowship Program at McGovern Medical School and co-director of The Fetal Center at Children's Memorial Hermann Hospital.

"Where are all the other babies?"

Currently, Papanna and his team are pursuing additional clinical studies and working to expand their approval from the FDA for more cases. They hope to apply the patch using fetoscopic repair techniques, which would reduce surgical risks to both the mother and the baby. Ultimately, they also aim to create a standard of care for babies diagnosed with spina bifida.

"Right now, the techniques being used to close the spina bifida are all over the map, and the outcomes vary considerably," said Moise, who recently returned from Botswana where the International Fetal Medicine and Surgery Society convened for their annual conference.

"Nobody has a standard way of treating this, but we all agree that whatever patches or fetoscopic approach we use, the outcomes should be judged against the MOMS Trial. We all want to develop something better than what we're already doing."

Moise expects that a standard of care, as well as increasingly positive outcomes, will also encourage OBGYNs to refer more of their patients to fetal centers for counseling.

"We should be three times busier than we are," Moise said. "There are over 200 babies born in Texas every year with spina bifida. Two hundred. And we might do eight or 10 cases a year. Where are all the other babies?"

Even more, he hopes standardizing treatment will change the climate surrounding fetal repair surgery worldwide. Currently, there are only a handful of sites outside the U.S. that do fetal surgical repairs. According to Moise, many countries, including most of Western Europe, consider a spina bifida diagnosis the equivalent of an unviable pregnancy.

"They think we're crazy to do what we do," Moise said.



We should be three times busier than we are. There are over 200 babies born in Texas every year with spina bifida. Two hundred. And we might do eight or 10 cases a year. Where are all the other babies?

- KENNETH MOISE, M.D.

TMCX DEMO DAY MEDICAL DEVICES 11.17.16

LOCATION

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#TMCxDemoDay

Dining In

Third Coast, a new restaurant, opens at the Texas Medical Center

By Britni N. Riley

THIIRD

LOCATION

John P. McGovern Commons 6550 Bertner Avenue, Sixth Floor

OPENING

Oct. 6

HOURS

Monday – Friday, 7 a.m. – 10 p.m. Saturday, 5 – 10 p.m. Closed Sunday

CATERING AND INFORMATION

713.749.0400 thirdcoasthouston.com Ome of the best ideas are born outside the office.
This month, the Texas Medical Center opens a new restaurant for the 100,000-plus people who come to work every day at the largest medical complex in the world.

Third Coast, a new dining experience on the top floor of the John P. McGovern Commons, emphasizes Gulf Coast cuisine and the melting pot of cultures feeding into Houston. The restaurant has been designed for all sorts of experiences—from a quiet drink at the bar to a full-course dinner with a dozen colleagues.

"This will be an upscale but comfortable space where physicians, researchers and others can meet for a meal without having to leave the campus," said Robert C. Robbins, M.D., president and CEO of the Texas Medical Center. "It's a chance for us to cater to our own community. We hope people from all parts of the medical center will come together at Third Coast."

Healthy options are a priority at the new restaurant.

"Ninety percent of the menu is gluten free and we are featuring a lot of protein and fresh produce,"

said executive chef Jon
Buchanan. "We wanted to
keep the menu very light
and healthy, but still offer a
lot of flavor."
Third Coast sources produce

from around the state, including
all-natural, pasture-raised beef from
44 Farms in Cameron; microgreens
from Moonflower Farms, located about
10 miles south of the medical center;
and farm-raised Redfish from
Palacios. The handmade, artisan
cheese comes from Houston

Dairymaids.

"I think the Gulf Coast
means seafood and there are a
lot of Hispanic, Asian, Czech and
German influences right here,"
said John Watt, managing partner
of Third Coast. "By combining the cultural influences we have here in Houston
with the fresh produce we get from the Gulf
and farm-raised cattle from around the state, we
get all of those elements to intermingle and become

The bar is stocked with products from Texas and farther afield

"Texas is known for a lot of great beers and spirits," Watt said, "and we have also hand-picked wines from



Apple tart with cinnamon ice cream

California, Oregon, Washington, Canada and New York to showcase the part of the world that we are in."

The atmosphere is elegant, but relaxed. With dark woods, marble, leather walls and hand-picked linens and china, Third Coast blends classic finishes with a contemporary edge. Visitors are greeted by a bar in mahogany and black marble, as well as a stunning view of the medical center from six floors up. In addition to the main dining area, the restaurant offers two private dining rooms and two conference rooms.

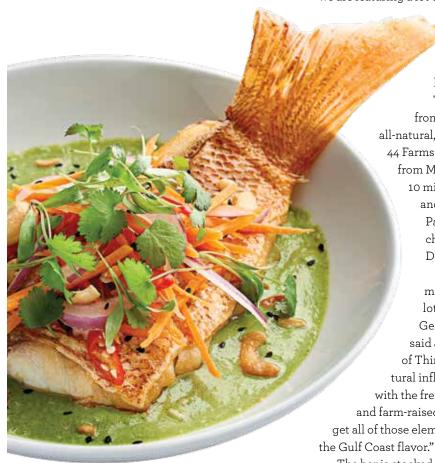
"We optimized the layout of the restaurant, creating small vestibules for private meetings in booths and large spaces for bigger parties," said William F. McKeon, executive vice president and chief strategy and operating officer of TMC. "You could watch TV in the bar area, enjoy a working lunch with a view, or tuck yourself into a booth and block out all the ambient noise. And the terrace couldn't be more welcoming. It has a roof and a fireplace, so it can be used year-round."

For the past 18 months, McKeon, Robbins and Shawn W. Cloonan, executive vice president and general counsel of TMC, have been overseeing the transformation of the former Trevisio space into Third Coast.

"It is hard to call it just a restaurant," said Lisa Pope-Westerman, a principal at Gensler, the architecture firm that designed Third Coast. "It is so much more than that. It is reminiscent of an academic club that is accessible to everyone in the medical center community."

Buchanan created the menu with managing partners Watt and Tracy Vaught, the team behind a suite of Houston restaurants that includes Prego, Backstreet Café, Hugo's and Caracol.

"I have worked in just about every kind of restaurant there is," Buchanan said, "and now I am getting to put a little bit from all of those experiences into this new flavor we are creating here."



Above: Red snapper with green curry and lemongrass-ginger rice. Facing page: Texas Prime Beef tartare with mustard aioli, truffle, shiso, watermelon radish and crostini, in the new dining room that overlooks the medical center.



Engineering Answers from the Ground Up

Rice University students seek solutions that can't be found in the back of a book

By Alexandra Becker



Oden sits in the Oshman Engineering Design Kitchen next to projects designed for real-world alobal health issues. Credit: Nick de la Torre

he first thing Leah Sherman Inoticed was how tiny the babies were. "Smaller than any infants I would ever expect to see," she said. Scanning the room, her mind shifted to the potential design flaws associated with the wooden "hot boxes" being used as neonatal incubators. With four incandescent lightbulbs serving as the heating source, temperature control would be tricky. But compared to many hospitals in Africa, where babies are wrapped in blankets and positioned close together on cots to keep warm, these boxes were innovative.

Sherman is a bioengineering

undergraduate at Rice University and part of a group of student interns and advisors from the Rice 360° Institute for Global Health who traveled to Blantyre, Malawi, this past summer to work alongside local physicians, nurses and engineers. When she visited the Queen Elizabeth Central Hospital's Gogo Chatinkha maternity wing, Sherman observed skilled surgeons, caring and knowledgeable nurses and an unrivaled work ethic. She also witnessed how easily cutting-edge technologies could fail.

"We would see these equipment graveyards," Sherman said. "Millions of dollars of broken equipment just sitting

66 This is not just an academic exercise where students get a grade and move on. 99

— MARIA ODEN, PH.D.

Co-director of the Rice 360° Institute for Global Health and Director of the Oshman Engineering Design Kitchen at Rice University

there, unused. Most of the time they knew exactly what was wrong, but they didn't have the parts to fix it."

Imagine the frustration of working in a ward where babies die each day, and the machines to prevent those deaths sit broken beyond repair in the hallway, a constant reminder to every passing health care worker of the lives they could be saving if only they had the right equipment.

"Sometimes people think that what you need to do is take existing technology from the developed world and just pull out features until it gets cheap enough to put in the developing world," said Maria Oden, co-director of Rice 360°. "I believe that's the wrong approach. I strongly believe that we need to be designing a technology from the ground up that is designed to meet the particular needs of that environment."

What this means for a NICU in Malawi is creating devices that can perform the same function as those in, say, the Texas Medical Center, but that are more durable—built to withstand heat and humidity and power outages—and, in some cases, made of parts that can be sourced locally.

Oden directs the Oshman Engineering Design Kitchen (OEDK), a working space for Rice engineering majors to collaborate on solutions to problems exactly like this. Housed in what used to be the main kitchen for the entire campus, the OEDK provides access to the tools, facilities and working space necessary to be creative. It is a hub of activity, with nearly 100 projects in process at any given time-not all related to global health. Topics range from energy and

sustainability to robotics.

"This is not just an academic exercise where students get a grade and move on," Oden said. "We want to pair a student's interest with a real-world project they're passionate about. What this means for students is that the stakes just got a little bit higher."

The projects come from community partners, or "clients," who have a tangible need for the inventive minds of engineers. Physicians from the Texas Medical Center, the energy industry, NASA and biomedical startups have all presented projects to the OEDK.

Considering that Rice's mission is to provide a solid and robust education for its students, the model is brilliant. Not only are students more motivated, but they are also gaining real-world experience that will prepare them for their careers. They work in teams across disciplines and learn lessons in leadership and project management. They're searching for answers that can't be found in the back of the book, discovering what it means to be good engineers, not just good students.

"Nobody builds their first prototype and has it work perfectly, even though on paper and in theory they do the calculations and everything should work great," Oden said. "Usually when they build it, something goes wrong; they made an assumption somewhere along the way, and then they have to figure out how to fix it."

Each spring, the students present their projects in the Engineering Design Showcase. The competition features design prototypes and provides an opportunity for students to practice their pitches with more than 80 judges as well as Rice faculty and students,

industry professionals and members of the community. The projects for the 2016 showcase in April were so impressive that the competition ended in a tie between two teams: "Brays Yourself" designed modifications to portions of the Brays Bayou in Southwest Houston to help reduce the 100-year floodplain in the area, and "Rice Outstenting" created a device to improve the process of removing ureteral stents.

Sherman and her design partner, Mikaela Juzswik, were each present, pitching their mechanical breast pump for low resource settings. It is elegant in its simplicity: a rocking chair powers the pump, so a mother could sit and rock while expressing her milk—no need for hands, and no need for electricity.

"In low resource settings, women don't have access to breast pumps because they're expensive," Sherman explained. "They're also difficult to repair if anything breaks, and if the electricity isn't reliable, there will be chunks of time when you can't operate the pump. This is extremely problematic because some children are too weak to suckle."

Hand-expressing is not efficient and formula is not sustainable—especially if it requires access to clean water. Through canisters and cycles of negative pressure, Sherman and Juzswik created an ingenious and comfortable solution.

Sherman took the prototype to Malawi where she received valuable feedback about the design. Although this trip was focused on neonatal hypothermia and the reliability and function of oxygen concentrators, the interns brought along a handful of additional prototypes, among them a temperature monitor for kangaroo care, a heating sleeve for the CPAP system and a pneumatic compression device. In addition to working with nurses and doctors at the Queen Elizabeth Central Hospital on employing new technology, members of the team also partnered with engineers and students at The Polytechnic, part of the University of Malawi, to focus on sustaining the technology.

On June 29, the Rice team attended the dedication ceremony for the Gogo Chatinkha maternity wing. The new expansion was made possible by fundraising efforts at Rice 360° and a generous gift from the program's codirectors, Oden and Rice bioengineer Rebecca Richards-Kortum. The two women donated \$100,000 in personal prize money from winning the 2013 Lemelson-MIT Award for Global Innovation.

"We couldn't imagine a better use for the money," said Richards-Kortum, Rice's Malcolm Gillis University Professor and recent winner of a MacArthur Foundation "genius" grant. "Already our student-created technologies are saving the lives of newborns at Chatinkha. We are excited to continue working together with local clinicians and teams of students from Rice and the University of Malawi to create more helpful technologies."

The fundraising campaign, dubbed the Day One Project ("make day one of a baby's life a day of celebration and survival"), didn't end with the expansion. Oden and Richards-Kortum are working with students on an ambitious project to develop a suite of 17 technologies designed specifically for low-resource settings. It will be a "Nursery of the Future" and, according to Oden, it could prevent more than 80 percent of all newborn deaths.

"Ninety percent of the world gets their health care in places where access to health technology is limited, so we need to figure out ways of providing the best possible health care in that environment," Oden said. "We believe that we can create a low-cost but effective suite of technologies to support essential newborn care at district hospitals in resource-limited settings."

Already, one of the OEDK's projects, the low-cost Pumani bubble CPAP (Continuous Positive Airway Pressure) machine, is in use at all central and district hospitals in Malawi. The device, which was initially prototyped using a Nalgene water bottle and a shoe box, delivers pressurized air to a newborn's lungs to treat respiratory distress syndrome—a leading cause of death among infants. It is as effective as traditional CPAP machines and, according to Oden, was shown to improve survival of babies with respiratory distress syndrome from 23.5 percent to 65.5 percent in a clinical evaluation at Queen Elizabeth Central Hospital in Malawi. Not surprisingly, the Pumani bubble CPAP has won grants from Save the Children and Saving Lives at Birth—a philanthropic partnership of multiple organizations, including the U.S. Agency for International Development and the Bill & Melinda Gates Foundation. It is currently being rolled out in more than 20 countries in sub-Saharan Africa, South Asia and the Caribbean.

And just this past August, another design baked at the OEDK was one of six technologies chosen for an 18-month validation grant by Saving Lives at Birth. The AutoSyP, which will be a component of the Nursery of the Future, is a low-cost syringe pump that works to reduce maternal mortality and improve neonatal health by delivering intravenous drugs or fluids in controlled amounts over a period of time. In developed countries, syringe pumps are considered standard and play a crucial role in treatment plans. An alternative like the AutoSyP, custom-designed for low-resource settings, has the potential to help millions.

If their goal is to tackle the biggest issues in global health while creating a new generation of ambassadors, then Oden and Richards-Kortum are right on track. Their reach has already extended to multiple countries. This past summer, student interns traveled to Barretos, Brazil, to identify patient needs and establish a good working relationship for future projects. Another group of students headed to the southernmost tip of Texas to test their diabetic ulcer wound-care model in Brownsville clinics.

"The opportunity for our students to tackle these problems that are really foreign to them, to also learn about society in other places and to learn about some of the challenges in delivering health care around the world, makes them better world citizens," Oden said.



Rice University students hard at work in the design kitchen. Credit: Nick de la Torre

TMC SPOTLIGHT

Q Can you tell us a bit about your childhood and family?

A | My father was a first generation immigrant from northern Italy. His family ended up settling in Houghton, Michigan, working in the coal mines. My father, who had an eighth grade education, contributed to supporting his family at an early age. He met my mother in the South, during World War II, and settled in Augusta, Georgia, where I was born and raised. I always did well in school and loved mathematics. When it came time to go to college, though, my mother said, 'Oh, you don't really need to pursue that path because you'll marry your childhood sweetheart and have a nice life.'

Q But you wanted to go to college?

A Yes, I valued education as a vehicle for advancement. Interesting anecdote. One night at the dinner table, my older brother said, 'Why don't you apply to Vassar?' He had just seen a James Bond movie where Kim Basinger does a karate chop and James Bond asks her: 'Where did you learn to fight like that, NASA?' She replies: 'No Vassar.' So my brother thought if I went to Vassar I'd be the coolest woman of all time. I applied and ended up getting a scholarship that paid for half my education. When I went to Vassar, it opened my eyes to a whole new world of opportunity.

Q What did you study at Vassar?

A | As a freshman I wanted to be an actress. Meryl Streep went to Vassar College; she was my commencement speaker. But my parents thought that was a terrible idea, so I became an economics major because math was always a strength for me. After Vassar, I wanted to explore my interest in science so I worked as a research assistant at Rockefeller University in a Nobel Laureate lab. With my economics degree, I had the opportunity to work for eight years with a startup team to bring Hoya, a Japanese glass corporation, to the U.S. market as director of marketing. Hoya expected me to continue on the business path and agreed to pay for my M.B.A. at Columbia University. I believed I could make a greater contribution in science, which

Julia Andrieni, M.D., vice president of Population Health and Primary Care at Houston Methodist Hospital and president and CEO of Houston Methodist Physicians' Alliance for Quality, speaks with Pulse about her acting aspirations, the happy collision of science and medicine, and the future of health care.



led me to medical school at the age of 31 as a second career.

Q How did that career shift feel?

A I always felt that it was just meant to be. It was really important to be able to combine science with the business of medicine in implementing transformative change at the individual and system level.

Q After studying and working in New York at Lenox Hill Hospital, an NYU School of Medicine affiliate, you ended up in Massachusetts at UMass Memorial Medical Center. What led you to UMass?

An opportunity to have a larger and more influential role at a medical school. At Lenox Hill, I was vice chair of the Department of Medicine and chief of the General Internal Medicine division. I had the same titles at UMass, but I had responsibility for a much larger faculty and budget with a greater clinical, educational, and research portfolio. The achievement of which I am most proud is that I started a mentoring program for the entire health sciences campus that included the graduate school of biomedical sciences, nursing school, and medical school. For this

work, I was named the Joy McCann Professor for Women in Medicine at the University of Massachusetts Medical School. Creating an environment for others to grow, advance, and succeed is important to me.

Q How much of your experience at UMass influenced your decision to come to Methodist in 2013? After all, Houston is a monstrous, complex city.

A I have always been interested in complex systems and how the pieces fit

66 People are complex, with specific health needs and motivations. One size does not fit all. 99

together in order to build new programs. Methodist had made a decision to build a premier primary care network as part of the vision of Dr. Marc Boom. I was fortunate to work with excellent teams that include Stephen Spielman and Dr. Chris Robben to recruit primary care physicians and Dale Clark and the Quality Integration Specialists to align independent primary care physicians in this network. It was an opportunity to build on my experience and lessons learned in Massachusetts and New York. Our guiding principles are patient-centric, and the timing was perfect because primary care was becoming the cornerstone of Population Health. As a leader and advocate for primary care, I thought: We can really make a difference and do this right for large populations in the greater Houston area.

Q | Let's talk about population health. I often refer to it as facility-based medicine. People show up at ERs or at their primary care physician, often at a time when their disease or an event has taken place, and they receive treatment and then return home, becoming somewhat disconnected from their care. I know population health has a different view on how we manage patients at a distance. Can you elaborate on that?

A | Population health management is a data-driven integrated health care delivery model that provides individualized care plans to populations based on health risks and conditions. We have different plans of care to accommodate the challenges of different populations and individuals. We are developing partnerships with community services to assist with food insecurity, transportation, and behavioral health needs. We are creating a congregational health network to connect patients to interfaith community partners so we can care for the whole person including their spiritual needs. If you don't address the social determinants of health, your health outcomes can be limited.

Q I would imagine the move now from fee-for-service to value-based health care is actually supporting population health more and more. Is that a good groundswell of support for programs that you're heading up?

A Yes, the transition from volume to value focuses on health outcomes and the coordination of individualized care. With the IT infrastructure to support predictive analytics and identification of gaps in care, we have the tools needed to direct resources to high risk populations. In addition, our Primary Care physician network has grown significantly to support the Greater Houston area. We have also been fortunate to build on the talents and successes of our Care Navigator program led by Janice Finder. People are complex, with specific health needs and motivations. One size does not fit all. A key component of population health is patient engagement to sustain outcomes. Patient portals and home health wearable devices educate and engage patients to better understand their condition. It takes high functioning teams to implement population health programs where the patient is at the center of the team. I am grateful for the work of many teams at Houston Methodist who provide the expertise, wisdom, and dedication to patients that improve the health of our populations.

Q | I almost forgot to ask: what's your perspective of the Texas Medical Center?

A There's absolutely nothing like it. I tell people it's a medical city of its own, with every entity side by side. When I first arrived, I thought this was downtown Houston! The number of people who come to work every day in health care in this one location—that is very Texas. If we could harness all of that energy, what a brain trust we would create!

Julia Andrieni, M.D., was interviewed by William F. McKeon, executive vice president and chief strategy and operating officer of the Texas Medical Center.



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ACCOLADES



CAROL J. BAKER, M.D., professor of pediatrics and of molecular virology and microbiology at Baylor College of Medicine, was selected to receive the 2016 Alexander Fleming Award for Lifetime Achievement from the Infectious Diseases Society of America. The award is granted to a member or fellow of the society in recognition of a career that reflects major contributions to the acquisition and dissemination of knowledge about infectious diseases. Baker's research is focused on neonatal infections and vaccine-preventable diseases.



RICHARD LEWIS, M.D., professor of ophthalmology and of molecular and human genetics at Baylor College of Medicine, received the National Foundation for Ectodermal Dysplasias' Outstanding Service Award for his significant contribution to the ectodermal dysplasias community. Ectodermal dysplasia is a group of conditions in which there is abnormal development of the skin, hair, nails, teeth or sweat glands. He was honored in July at the foundation's annual Family Conference.



YOCHAI BIRNBAUM, M.D., professor of medicine - cardiology and the John S. Dunn Chair in Cardiology Research and Education at Baylor College of Medicine, received the Walter Bleifeld Memorial Award at the annual scientific sessions of the International Academy of Cardiology, held at the 21st World Congress on Heart Disease. The award recognizes distinguished work in the field of clinical research. Birnbaum's clinical interests are non-invasive cardiology, echocardiography, electrocardiography, clinical cardiology and acute coronary syndrome.



GAY NORD, has been appointed president of CHI St. Luke's Health-Baylor St. Luke's Medical Center. Nord joins CHI St. Luke's Health from Methodist Hospital in San Antonio, where she served as president and chief executive officer for five years. With more than 20 years of experience in health care and an academic focus, Nord brings the commitment to quality with an emphasis on outstanding and cost effective care delivery needed to lead the hospital into the next era.



HOPE COOK, B.S.N., R.N., C.H.P.N., the education coordinator for Houston Hospice, has received a Bronze Excellence in Nursing Award from the Good Samaritan Foundation. Cook has been a practicing registered nurse since graduating from Texas Woman's University 41 years ago. In her new role as educator for Houston Hospice, she has created several new programs and works diligently toward positive outcomes in patient care through education.



DARELLE ROBINS, M.S.N., R.N., patient care coordinator at Houston Hospice, was honored with a Bronze Excellence in Nursing Award from the Good Samaritan Foundation. Robins has been a nurse for 27 years and is an inspiration to her peers. Beyond her medical expertise, families express appreciation for the calming and reassuring presence Robins provides.



SVANHANIEL CRIM, B.S.N., R.N., an R.N. case manager at Houston Hospice, has received a Bronze Excellence in Nursing Award from the Good Samaritan Foundation. This year, 249 nurses were nominated by their peers from hospitals, clinics, colleges and universities throughout Houston. Crim embarked on her nursing career 40 years ago after graduating from the University of Texas System School of Nursing, and she has served as a leading member of her Houston Hospice care team for more than six years.



EARL SHIPP, vice president of operations, U.S. Gulf Coast, The Dow Chemical Company, has been appointed to the CHI St. Luke's Health System's Board of Directors. Since joining Dow Chemical in 1981, Shipp has held numerous domestic and international leadership positions. In his current role, Shipp oversees nine manufacturing sites including Texas Operations, the largest integrated chemical manufacturing complex in the world.

October 2016

6 The Inaugural Texas Medical Center Hispanic Transplant Symposium

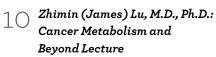
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James T. Willerson, M.D.,
Cardiovascular Seminar:
Scott A. LeMaire, M.D. presents
"Mechanisms of aortic wall damage
and repair in sporadic thoracic
aortic disease"

Thursday, 4 – 5 p.m. Texas Heart Institute 6770 Bertner Ave.

vsweed@texasheart.org 832-355-9144



Monday, 4 – 5 p.m. Houston Methodist Research Institute 6670 Bertner Ave.

events@houstonmethodist.org 713-363-9049

12 Music Therapy in the Texas Medical Center: A Symposium

Wednesday, 7:30 – 11 a.m.
Third Coast Restaurant
6550 Bertner Ave., 6th Floor
\$50; registration required
jdtownsend@houstonmethodist.org

713-441-9231



Maegan Morrow, a board certified music therapist and neurologic music therapy fellow at TIRR Memorial Hermann. Credit: Nick de la Torre

14 Institute of Spirituality and Health Annual Nursing Conference

Friday, 7:30 a.m. – 3:30 p.m. St. Paul's United Methodist Church 5501 Main St.

\$85 for nurses; \$35 students and retirees jdoctor@ish-tmc.org 713-797-0600

Cameron School of Business Graduate Open House

Saturday, 11 a.m. – noon University of St. Thomas Welder Hall 3812 Yoakum Blvd. cameron@stthom.edu 713-525-2100



OCTOBER: BREAST CANCER
AWARENESS MONTH

Breast cancer is the most common form of cancer diagnosed in women, according to the World Health Organization.

An estimated 250,000 women in the United States are diagnosed each year. Monthly self-examinations and regular mammograms help in early detection. Breast Cancer Awareness month reminds women to take the necessary steps to prevent this disease.

Researchers and physicians across the Texas Medical Center are working to lower fatality rates related to breast cancer through genetic testing, hormone therapies and surgical procedures.

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