CANCER'S *worst nightmare*

Our professors work on everything from cures to even helping reproduction for survivors.

For associate professor Doug Frantz, he watched three of his uncles on his mother's side all succumb to brain cancer. Each was gone after less than 14 months from diagnosis. "This disease is devastating," he says. "I can't ever forget what it did to them."

Cancer. It's a word that affects practically everyone.

And UTSA is no exception. Researchers on some of our leading projects have lost those close to them—for one, seemingly a whole side of his family. But our school touches more than just surviving, but thriving. Beating this gut-wrenching disease takes dedication, patience and time. As you'll learn, these teams of professors and students have all three.

LIFE AFTER CANCER

"Oncologists are so focused on trying to keep people with cancer alive that they can overlook the other things," says assistant professor Brian Hermann.

Those other things include the ability to have children and has led Hermann and his laboratory group on an odyssey of hope.

"Many people don't realize that radiation and certain types of chemotherapies—such as alkylating agents—can be toxic enough to the testicles that treating cancer can result in permanent infertility…" he says. "And a question many people don't think about is—what does this mean to the young boy who hasn't even reached puberty? Patients undergoing bone marrow transplants for cancers like certain leukemias and even some non-cancerous metabolic disorders, they many times end up unable to have kids."

His research looks at using stem cells to restore sperm production, making it possible that cancer survivors will be able to have children, regardless of the treatments needed to beat cancer. "What few know is that sperm are made from a special kind of stem cell found only in the testicles and, if a patient will receive

ILLUSTRATION BY STEPHEN DURKE

chemotherapy or radiation treatments that will make them infertile, we could save those stem cells before cancer treatment and transplant them into the testicles later where they will start making sperm again," he says. "The patient can be naturally fertile again."

Hermann and his team are also studying how these spermatogonial stem cells (SSCs) work, how they normally make sperm and whether other types of stem cells could be used to make sperm. The students and staff in Hermann's lab are even investigating whether the testicular stem cells could be spared from being damaged by chemotherapies and radiation. "What if we could prevent infertility in cancer patients altogether?" Hermann says. "We are looking at ways to head off this problem from the very start."

Beyond the physical, Hermann stresses that there is also a psychological aspect to infertility due to cancer. "This is a passionate area for a lot of people who are infertile and desperate to make sure they can have children," he says. "For many, infertility is one of the worst things that can happen. It may destroy their dreams and can have a huge effect on their state of mind. The silver lining is that because childhood cancer patients are surviving like never before, now we have to think about ways to prevent infertility from happening."

In addition to helping cancer patients, this research may benefit patients who become infertile for other reasons. "We're talking to the US Army Institute for Surgical Research about whether our work can help soldiers who have suffered major traumatic injuries to their genital system and are faced with infertility," he says. "If we can we use the same types of technology to make sperm in a Petri dish, our wounded warriors might be able to have children. What we learn from helping infertile cancer patients might help us tackle infertility in other patients, and vice versa."

SHINING A LIGHT

Sometimes it's a simple question which can lead to a complex and compelling result. Dr. Matthew Gdovin found that out through an open exchange of ideas with a student. What resulted has illuminated this associate professor's whole career.

Having spent the past 17 years studying the nervous system as it relates to respiration, it was only last year that his research turned in the unlikely direction of cancer. "I was actually studying the respiratory circuit in brain stems of tadpoles," he says. "It looked at carbon dioxide detection and acid detectors. You hold your breath and it becomes more acidic." His lab would set out to do that with a hydrogen ion, hitting it with a type of UV light.

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Then a student of his threw out this hypothesis: "What if you could make it really acidic and it will make the cell commit suicide? Can we make cancer cells kill themselves on the inside?"

It was, Gdovin had to admit, an excellent question.

"Through what we're doing, we can take a nano particle and it would go into the tumor cells," he explains. "If you shine an infrared, it goes three inches through human tissue—like shining a flashlight."

Performing the acid effect in a Petri dish with breast cancer cells, Gdovin says the cells were dead within three hours.

This research gave a chance to shine a light on the young talent at UTSA as well. In fact, three students are on the patent of this work, along with the professor. "It's actually my first patent, too," Gdovin says. "I love that they have that achievement already. Students deserve recognition for great ideas and doing great work. These students were motivated and understood the opportunity this could present to medicine."

Imagine if this could one day replace chemotherapy. As alluded to in Hermann's research, it's not just the disease that affects a patient's life but what's used to treat it. "To even just create something less invasive that could be just as effective…" Gdovin says. "That could make a huge difference."

And the work has made a difference to Gdovin through already seeing his protégés blossom. "The fact students were so involved is part of the joy of it," he says. "You can't underestimate what they can bring to research. Sometimes it takes someone young, someone unaffected, who's just looking at the problem from a new angle. They teach me as much as I teach them."

FOR HIS UNCLES

Many times cancer seems to choose its victims indiscriminately—but, of course, that isn't always the case. For associate professor Doug Frantz, he watched three of his uncles on his mother's side all succumb to brain cancer. Each was gone after less than 14 months from diagnosis. "This disease is devastating," he says. "I can't ever forget what it did to them."

His lab has been devoted to eradicating this form of cancer, Frantz and his students grabbing on to research and trying to push it through. "The current treatments get the bulk of the tumor," he says, "but that *center* of the tumors, that cancer stem cell becomes resistant to radiation and chemotherapy. It comes back. I'm a synthetic organic chemist who spent years at Merck and in university life. I've never had a challenge like this one."

But, Frantz, who is the co-director of the Center for Innovative Drug Discovery with UTSA's Max and Minnie Tomerlin Voelcker Medicinal Chemistry Core Facility, quickly reminds us that a stem cell can just as easily be positive as negative. "It can become a muscle cell, a bone cell—we don't need to kill them, we just need to 'convince' them not to become cancer any more. The life expectancy for brain cancer patients is 14 months. We're trying to identify molecules that can have an effect."

He admits the research is gratifying yet frustrating. "You have to isolate the population of stem cells, get away from the tumor then make sure you know how to keep those cells alive," he says. "And, besides that, test your molecule line! Just learning that is tough. We've had to learn biology ourselves for those of us who are trained in chemistry."

Frantz's work led to him being bestowed the Max and Minnie Tomerlin Voelcker Fund's Young Investigator Award, the first time it was ever awarded to a UTSA researcher.

"A devastating disease like this will take a huge push," he says. "We owe it to everyone who's been touched by someone who's gone through this. It takes away everything. We need to tell brain cancer goodbye."

IRON IT OUT

UTSA clearly seems to have it in for cancer cells. First we tell you we want to kill them with acid and now… iron? Professor Donald Kurtz and his team are focused on their own photochemical cancer therapy to do just that. The treatment is driven by a nano-scale protein scaffold filled with approximately 2,000 iron atoms in its hollow center. The scaffold will bind like Velcro to cancer cells because the peptides, molecules made of amino acids, on its outer shell are recognized specifically by the cancer cells.

"Iron is essential for all cells in the body to function properly and is safe up to certain levels—however, the cells' iron transfer process is highly regulated," Kurtz says. "If we overload cells or tissues with iron, they become toxic. Our goal is to develop a method for delivering iron at toxic levels specifically to cancer cells."

After researchers deliver the iron-loaded scaffold to cancer cells, they will zap the scaffold with tissue-penetrating, near infra- red light. The light treatment will cause the scaffold to release its iron into the cells. The released iron will induce the production of free radicals, which, at sufficiently high levels, will overwhelm the cells' antioxidant capacity, thereby killing the cells. The peptide on the outer shell of the protein scaffold can be varied to target specific types of cancers, such as breast or prostate. "The basic idea is to use light as the trigger to shoot iron out of our protein scaffold and into the cancer cells," said Kurtz. "Think of it as shooting iron bullets to kill cancer."

For Kurtz, who spent many years instructing at the Georgia Institute of Technology, the opportunity to pursue this kind of project has been a different kind of exhilaration. "It's a long road but think about what's on the other side," he says. "There are people waiting for the results we're shooting for. I think we're all driven by a chance to make a real difference in other people's lives."

A STUDENT OF A CANCER LAB —NOW UTSA LECTURER

Hector Aguilar knows just what a student can experience on cancer-related projects at UTSA. He's gone from being a graduate student in Doug Frantz's brain cancer lab to a post doctoral fellow showing other students the way in that very project. It even was a major factor in him becoming a lecturer at UTSA this past school year. We talk with Aguilar about his experience in the lab and its influence.

CATALYST: *What are the best opportunities for students in the lab?*

AGUILAR: It's only as limited as you want it to be. I remember a student (Shane Appel) who was about to go to medical school and wanted to see if he could get a heart cell to live in a Petri dish. I said go ahead. And then he tells me that he and his team did it! I was shocked and impressed! Really this lab wouldn't be anything without our students, going all the way down to undergrad. We want to get them involved and have them be a part of discoveries—not just be a pair of hands.

CATALYST: *What has the experience of the lab done for your career?*

AGUILAR: It's just very exciting to see the strides we've made. We are focused on the goal of what we can do with stem cells. I've had a chance to teach other students because Dr. Frantz encourages these learning opportunities. The joke is that the students have become "my army." I really want to lead them forward.

CATALYST: *It sounds like Dr. Frantz has had a strong influence on you.*

AGUILAR: He's one of the reasons I'm now a teacher. I saw his passion for teaching and it makes you realize the impact you can have—he even asked me if I wanted to be a teaching assistant. He's one of the big reasons so many students want to be a part of the lab. One example of how he helps was when he took many students to Merck and Bristol Myers Squibb so we could have a close-up view of industry.