UNRAVELING THE MYSTERIES OF PAIN
There's nothing simple about pain. The ancients thought that pain was all in the brain, but pain also wracks people's psyches, jangles their nerves and makes their backs throb. Pain costs Americans up to $635 billion each year for medical treatment and in lost productivity, says the Institute of Medicine of the National Academies. That hefty price tag is equivalent to the first 10 years of spending for homeland security, illustrating a nationwide problem of giant proportions.

An estimated 116 million Americans live with chronic pain, and one of them happens to be Dr. Jelena M. Janjic, assistant professor of pharmaceutics in the Mylan School of Pharmacy. As a scientist and as an individual, Janjic was looking for answers, so she approached several faculty members in 2011 to form a multidisciplinary group focused on chronic pain, to explore it as a disease itself and as a byproduct of injuries and diseases such as cancer and Parkinson's.

The goal was to introduce new ideas into pain research and bring people together across disciplines who typically would not work on pain or even collaborate. Strategically, the founding group—now known as the Chronic Pain Research Consortium—was very diverse.

“Only an integrated approach to pain research may bring new and effective treatments,” says Janjic.

Dr. John Pollock, professor of biological sciences in the Bayer School of Natural and Environmental Sciences, responded to Janjic’s invitation. The two have been joined by faculty with expertise in pharmacology, medicinal chemistry, molecular imaging, animal behavior, pharmacetics immunology, neuroscience, neuropharmacology and neurobiology. Fluent in knowledge of the immune system, stress and systems involved in treating cancer and nerve pain, fibromyalgia and other diseases, they decided to tag-team the persistent problem of pain.

The work of the group, which includes faculty from five schools across the University, inspired Provost Dr. Timothy R. Austin to establish a University fund to encourage “grass-roots research collaborations” to unite different disciplines to resolve some of society’s biggest issues.

The consortium received the first Provost’s Interdisciplinary Research Consortia Grant award of $25,000 in July and is growing in many directions, thanks to professors’ dedication and funding from federal and foundation sources—such as the National Institutes of Health, The Parkinson’s & Movement Disorders Foundation and the American Pain Society—that already totals about $1.8 million. Here are some examples of how Duquesne researchers are tackling the pain challenge.

WHERE DOES IT HURT?
NEW PROCESSES COULD PROVIDE PERSONALIZED PAIN TREATMENT

Most pain studies focus only on biology or behavior, drug delivery or microscopic cell anatomy, but the research of Janjic and Pollock incorporates each of these areas to personalize pain treatment. Their methods could enable doctors to pinpoint where pain is originating, then provide medication to that precise location—allowing a smaller dose of medication to be effective in curtailing pain while creating few side effects.

This could be a breakthrough for treating pain, Pollock explains, because soreness in one location might actually be caused by a pinched nerve or issue elsewhere.

“The process relies on the interplay between the immune system and the nervous system to work,” he says.
Integrated chronic pain research vision

The first step is to envision the pain with Janjic and Pollock’s non-invasive fluorescence imaging and MRI imaging achieved in collaboration with Carnegie Mellon University, pinpointing the origins of pain-inducing inflammation. Next, researchers specifically locate the immune cells involved in pain, then target them with medication.

Janjic has pioneered targeted drug delivery to treat pain, developing nanodroplets that, when injected intravenously, accumulate at the inflamed areas. This process could have a huge impact for people with inflammation-related pain, including osteoporosis and arthritis. Patients now are often prescribed pain-alleviating drugs, which over time, tend to be less effective and can damage the liver, kidneys, brain and other organs as they accumulate in the body. The nanodroplets allow drugs to be administered at a lower-than-typical dose because they wouldn’t travel through other body systems. Future studies will continue to refine the process.

“We’re helping to fulfill a completely unmet need in pain research,” says Janjic.

INVESTIGATING EXERCISE AS A TREATMENT FOR EMOTIONS AND MORE

Dr. Benedict Kolber works at the intersection of sensory and psychological response, dealing with both brain and bladder. An assistant professor of biological sciences and consortium member, Kolber has been trying to unravel one of chronic pain’s least discussed ailments: interstitial cystitis bladder pain syndrome. About 1.3 million people cope with this condition that causes frequent bathroom trips coupled with pain, altered sleep habits, loss of productivity and social stress. The medical community currently throws its hands in the air when asked how to deal with this problem that exhibits no visible signs.

Kolber and his team made a scientific breakthrough connecting the painful bladder condition with the amygdala, an area in the brain that regulates emotions and stress reactions. Stimulating the right side of the amygdala increases the body’s response to bladder distention, so the team now is working to find a medicine that would block this stimulation, reduce symptoms and help those who suffer.

Expanding his foray into the emotional and physical connection, Kolber is studying how depression and anxiety often come to accompany chronic pain.

“If we manipulate the brain and eliminate pain, maybe it will help with depression and anxiety, too,” says Kolber.

Kolber works independently, but also as part of a research duo and team looking at different facets of this issue. With Dr. Kevin Tidgewell, assistant professor of medicinal chemistry in the Mylan School of Pharmacy who harvests natural ocean products and investigates their pain-killing compounds, Kolber is examining the possibility of treating pain and depression together and
whether these two conditions happen in the same spot in the brain.

One of the consortium’s most wide-ranging, multidisciplinary efforts aligns Kolber and Tidgewell with Dr. Kimberly Szucs of the Department of Occupational Therapy, Dr. Matt Kostek of the Department of Physical Therapy and Dr. Alex Kranjec of the Department of Psychology to look at exercise and pain, plus ways to talk about pain.

“Exercise is one of the best antidotes for pain and one of the best antidepressants ever discovered, but people with depression and in pain don’t want to exercise for a variety of reasons,” says Kolber.

The group is looking to break this cycle by determining the least amount of exercise needed to reap pain-reducing benefits—data that is now non-existent.

In addition, the group is focusing on the language used to describe pain and the quantitative sensory testing of an individual’s pain threshold.

“We could develop better monitoring; we could map an individual’s progress over time, on how pain affects their sleep, work and relationships,” explains Kolber, noting that this information could support health care that would improve patient functions on a daily basis.
MUSIC THERAPY: ALUMNUS FINDS WAYS TO TUNE OUT PAIN

As a music therapy major, Sam Rodgers-Melnick, M’12, believes the Bob Marley quote: “One good thing about music, when it hits you, you feel no pain.”

As a practitioner and researcher, he sees daily that music can reduce the acute and chronic pain of cancer and sickle cell anemia.

A board-certified music therapist at the University Hospitals Seidman Cancer Center in Cleveland, Rodgers-Melnick works with adults receiving cancer treatments and adults with sickle cell anemia, who generally face unpredictable pain crises throughout their lives and often must be admitted to the hospital. The genetically misshapen, oxygen-carrying red blood cells clog in blood vessels and create agony that can damage bones, organs and nerves.

Rodgers-Melnick started working with adult sickle cell anemia patients as a music therapy intern at Seidman, which treats more than 240 adults. He conducted music therapy sessions with patients, family members and staff using drumming to help manage pain and build positive interactions between the staff and the patients.

Patients reported less pain, and feeling more connected with the medical staff and more supported by each other. But one patient’s enjoyment is another’s noise, so Rodgers-Melnick devised a way to keep music personal in shared spaces: a technological wonder called the Seidman Studio, a mobile recording studio with an electronic drum set, keyboard and guitar plugged into a laptop, sending good vibes out through headphones.

“It’s nice having that music technology background from Duquesne,” he says. “I rely on it a lot of the time when working with my patients.”

Music’s soothing effect can be dismissed as a mere distraction, Rodgers-Melnick says, but patients may respond emotionally even when only listening to the music. Part of the reaction may be that patients have so little control over their bodies, the hospital environment and their needed medications and therapies that music becomes even more wonderfully engaging.

Music can also carry information, like Rodgers-Melnick’s raps with teenage patients transitioning to adult care, learning about medications and lifestyle decisions.

Patients may report less pain after 20 to 30 minutes of making music, though music therapy also occurs when patients are well, not just in pain crises. From young guys to 80-year-old grandmothers, Rodgers-Melnick hears feedback that “music therapy helped my pain and made me feel like what I have to say matters.”

“It changes the way they think about pain,” Rodgers-Melnick says.
RISKS AND BENEFITS: DIGGING DEEPER INTO HOW WE TREAT AND STUDY PAIN

For decades, medicine has relied upon opioids and non-steroidal anti-inflammatory drugs, such as aspirin and ibuprofen, for pain relief. “They are still our two frontline pain medications,” says Kolber. “But patients are suffering; most therapies treat the symptoms, not the underlying cause, because so much is unknown in pain.”

America’s pain epidemic intersects with the growing abuse of prescribed medications, creating a dilemma for people who might be able to benefit from medications, as well as for doctors who prescribe them. The fear of addiction is a concern for some pain sufferers, says Dr. Vincent Giannetti, professor of social and administrative pharmacy, and a specialist in substance abuse, and mental and behavioral health. He is initiating a survey with Dr. Khalid Kamal, associate professor of clinical, social and administrative sciences for pharmacy, and Dr. David Provenzano, an adjunct professor at Duquesne and a chronic pain specialist with the Ohio Valley General Hospital, to see how Pittsburgh-area primary care physicians handle this issue.

“There’s large variability in prescribing for pain conditions, so we’re developing a study to see what guidelines physicians adhere to,” says Giannetti.

In addition, the team will study physician knowledge, patient assessment and patient monitoring. “The subjective nature in the perception of pain results in difficulty in applying specific guidelines to pain management with individual patients,” says Kamal. “The research is attempting to understand this gap.”

People with the same level of tissue damage and injury will not report the same intensity of pain experience, Giannetti says, and individual characteristics also are critical in the risk of addiction. The reason for taking pain medication plays a key role in becoming addicted, according to Giannetti. Those with a personal or family history of addiction, and those who are anxious or depressed or are using the medication to avoid or escape painful emotions are at a much higher risk. Yet, underprescribing pain medication presents a problem.

Plus, Giannetti asks, how do doctors consider psychological approaches to pain management, such as meditation, systematic relaxation, guided imagery, cognitive therapy and hypnosis? Physicians, patients and policymakers all may be interested in the research results.

“Whether it’s acute or chronic, pain influences every aspect of our lives.”

PAIN RESEARCH LEADS TO NEW TEACHING TOOLS

(Another project, headed by Dr. Lynn Simko, clinical associate professor of nursing and a certified critical care nurse, and Dr. Diane Rhodes, an instructor of pharmaceutical sciences who practices in institutional settings, is examining the administration of pain medicine in institutions and nurses’ attitudes toward pain treatment.

They have created the consortium’s first interdisciplinary course, Etiology, Assessment and Treatment of Pain for the Health Care Professional.

Pollock is leading an educational project—which recently received a $1.3 million National Institutes of Health (NIH) Science Education Partnership Award—aimed at teaching biology, neuroscience and health literacy principles to school-age children through interactive media that, among other things, will explain why we feel pain. He recruits students from across campus and other consortium members to help develop concepts for these new teaching tools.

GAINING FROM THE GROUP APPROACH

Acknowledging the widespread impact and complexity of pain, six federal agencies—from the NIH to the Department of Defense—announced in May the creation of a database of pain research and training activities to make them more accessible. The University and federal group efforts function similarly, aiming to raise the level of research and results.

“The consortium allows us to operate at a scientific level we couldn’t do otherwise,” says Kolber. “Whether it’s acute or chronic, pain influences every aspect of our lives. We don’t know what causes this disease and we don’t fully know the influence it has on our entire lives, including sleep patterns and emotional well-being.”

Despite the mysterious nature of pain, Duquesne researchers are working to better understand it so that others lead healthier and happier lives.

More about Duquesne’s Chronic Pain Research Consortium is online at www.duq.edu/pain.