



tech transfer for nebraska



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A decorative background image featuring a red rope running vertically on the left, a white rope running horizontally across the middle, and a black rope running diagonally from the bottom left. A black knot is visible where the red and black ropes meet on the left side.

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Letter from the President

Reaching for new heights



Michael Dixon

Michael Dixon, Ph.D.
President and CEO

It would be easy to recite all the big, shiny numbers that measure another successful year for UNeMed; however, 2018 was a little more special than that.

We saw some big changes that merit special attention.

In December, UNeMed signed a new technology services agreement with our friends at the University of Nebraska at Omaha. The agreement removed some old administrative barriers and makes UNeMed services more accessible to the entire campus.

That new and improved bond propelled UNeMed—and the University in general—to greater heights in 2018. Even before the new service agreement, we often worked with UNO inventors in the past, but we've never seen more than five inventions in an entire year (2013).

In a little more than six months, UNO's innovative faculty, students and staff submitted 27 new inventions. Remarkable.

But put those numbers aside for a moment. The much larger boon is in UNO's people. Experts in fields that UNMC's talented researchers and innovators don't often see. The talent at UNO brings an entirely new perspective to UNMC research and innovation. That expands the University's ability to achieve its core mission, which is to serve all the people of this state. And we do that here by advancing the kind of technologies that improve our health, our happiness and our economy.

UNO's Information Science and Technology department can shave years off the development of software solutions to some serious healthcare problems. In fact, those collaborations are already underway, and I can't wait to see what impacts await us down the road.

UNO's biology department is working with a UNMC startup, Prommune, to develop new vaccines; and I think most people know about some of the incredible work that emanates from the world-class Biomechanics Facility. Truly next-generation stuff is emerging from that pipeline and will include things related to prosthetics, concussions and COPD, to name a few.

There aren't many Universities that share our ability to leverage the regional epicenter of healthcare research and clinical care of the Med Center with the explosion of engineering, business, computer science and biomechanics.

UNO and UNMC are poised for something special as this continues to grow.

UNO's impact will be so much more than numbers, but their addition made a clear difference. Their 27 disclosures helped set a new record in our 27-year history with 111 new inventions. That's a 37 percent increase over the previous year, and five more than our previous record set back in 2012.

It's clear to me that bringing UNeMed and UNO together was one great leap toward helping two campuses scale barriers to greater summits and more fruitful collaborations in the near and distant future.

THE VIEW FROM ABOVE

Stepping back a little further, it's worth noting that we received 42 issued patents—21 U.S. patents—in fiscal year 2018. That is a 25 percent increase over the previous year, but the more important point is that 15 of those U.S. patents are licensed or optioned to an industrial partner. That is significant.

It means that more than 70 percent of those protected technologies have intense market interest—enough that companies are willing to invest precious resources in helping develop those technologies into products for the marketplace.

In a broader context, I'm proud to report that our overall patent portfolio is 67 percent licensed to industrial partners.

That is also significant. While applying for and obtaining a patent is a significant step – it is not the end metric. By licensing 67 percent of our patent portfolio,



Sachin Pawaskar, Ph.D., (left) and Thang Nguyen chat shortly before UNO's IS&T Capstone presentation on June 1, 2018. The project was the realization of WeChart, Nguyen's invention of a more effeiceint way to teach nursing students better clinical charting skills.

LETTER *continues on next page*

Letter

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UNeMed has proven that we not only care about identifying and protecting new ideas – but we make sure those ideas have a commercial partner that will invest significant resources to see that technology developed into products that improve healthcare.

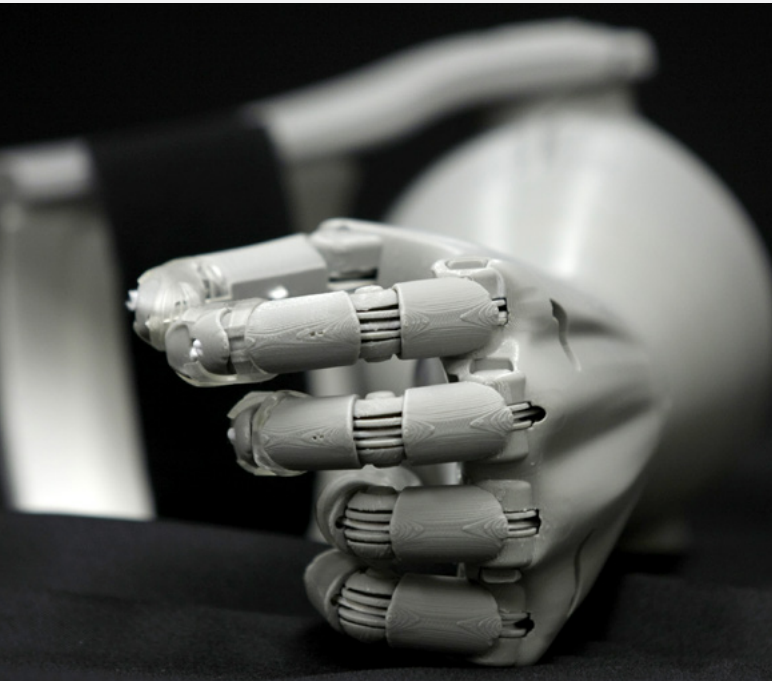
LOOKING FORWARD

Finally, I'd like to add a few words about what's coming.

I'm pleased that the Tech Transfer Boot Camp successes continues, and helps fulfill a part of our educational mission. The Boot Camp, along with the EMET program—and the budding relationship with UNO's IS&T Capstone program—will continue into the foreseeable future.

More interestingly, however, we also rolled our annual Shareholder Meeting into the Innovation Awards for what was the most highly received event since I joined UNeMed 15 years ago. We are looking forward to improving that event in the coming years as well.

And, finally, as I write this, we're planning a regional drug development partnering conference in flyover country. At the time this publication went to press I can't say how well the conference performed or how well it was received, but in the weeks leading up to the event all signs point to positive. I fully expect to report a positive outcome in these pages next year, and perhaps even extend a realistic hope of making Omaha an annual gathering place for our regional university colleagues to partner with national and international pharma, biotech and venture capitalists in the years to come.



INNOVATION AWARDS

Suh named Emerging Inventor of Year

Pediatric ophthalmologist Donny Suh, M.D., was named the 2017 Emerging Inventor during UNeMed's annual Research Innovation Awards Banquet on Thursday, Oct. 26, 2017.

In addition to recognizing the work of all inventors at the University of Nebraska Medical Center and the University of Nebraska at Omaha, UNeMed also announced the Most Promising New Invention of 2017. That award was received by co-inventors Mark Carlson, M.D., Jingwei Xie, Ph.D., and Shixuan Chen, Ph.D.

Thier invention, a nanofiber sponge, was soon-after licensed by an undisclosed commercial partner in January 2018.

Held at the Michael F. Sorrell Center's Truhlsen Campus Events Center at UNMC, the Innovation Awards Banquet recognized inventive faculty, students and staff at the University's Omaha campuses. The event rewards the achievements of those who submitted a new invention, received a U.S. patent or licensed a technology during the previous fiscal year.

James Linder, M.D., delivered a keynote address that explored five key elements of innovation. His main points included the power of the university; the patience needed for the "long road of innovation;" knowing your own strengths and weaknesses; and seizing the opportunities that arise during the accumulation of experience.

His final point centered on the reward of innovation. It's not the potential of financial gain that keeps the wheels turning on the road from the idea to commercial success.

"The ultimate reward is improving lives," said Dr. Linder, who served as the Interim President of the University of Nebraska in 2014. "The real reward is seeing your research or discoveries actually put into practice."

Dr. Linder led the University Technology Development Corporation before taking the CEO role at Nebraska Medicine in August.

The evening began with brief remarks from UNMC and UNO Chancellor Jeffrey Gold, M.D., who told an estimated crowd of 148 about the University of Nebraska's value to the state, region and nation at large.

Nebraska is "a critically important part" of the future,



Donny Suh, M.D., was named UNeMed's Emerging Inventor of the Year during the 11th annual Research Innovation Awards Banquet on Thursday, Oct. 26, 2017.

INNOVATION AWARDS *continues on next page*



Innovation Awards *Continued from previous page*



he said, creating tomorrow's workforce; developing the next generation of treatments, cures and discoveries; and providing power to the local economic engine through its technology transfer efforts.

"I just wanted to make sure that you heard loud and clear how much we appreciate you, and that I personally appreciate everything you do," he told a room full of academic researchers and inventors.

Dr. Suh, the Emerging Inventor winner, developed several new inventions during the previous fiscal year. An associate professor in UNMC's department of ophthalmology and visual sciences, Dr. Suh submitted five inventions in 2017, four of which allow for more precision and stability while performing delicate procedures on or around the eye. They include clever designs to common medical tools such as a syringe, forceps and a needle holder.

Drs. Carlson, Xie and Chen earned the most promising new invention award for their collaboration on a medical device that has the potential to stop severe bleeding. The device is a sponge made from nanofibers using a proprietary process. The sponges show particular promise in traumatic abdominal injuries, where applying pressure to stop or slow bleeding would be almost impossible.

The sponges are more absorbent than traditional sponges, and yet retain their overall size and shape. They can also be manufactured into a wide range of sizes and shapes to fit differing needs. Dr. Carlson is a professor in UNMC's department of surgery, and Dr. Xie is an assistant professor in UNMC's regenerative medicine program. Dr. Chen is a post-doctoral research associate at UNMC.

Other innovation Week events included a Kick-Off event; a panel discussion about intellectual property issues that might emanate from the CRISPR/Cas9 gene editing tool; a hands-on workshop aimed at helping researchers perform their own patent searches; a panel discussion about alternative science careers; and a luncheon focused on celebrating Nebraska women in science, technology, engineering and math. The luncheon was hosted and sponsored by BioNebraska.

Learn more about all Innovation Week events at <https://www.unemed.com/innovation-week>.

James Linder, M.D., then president of the University Technology Development Corporation at the University of Nebraska, delivered the keynote address at UNeMed's 11th annual Research Innovation Awards Banquet on Oct. 26, 2017. Dr. Linder is the former President and CEO of UNeMed and also served as Interim President of the University in 2014. In August he was named CEO of Nebraska Medicine.



Award History

Most Promising New Invention		
2017	Jingwei Xie, Ph.D. Shixuan Chen, Ph.D. Mark Carlson, M.D.	Nanofiber Sponges for Hemostasis
2016	Joyce Solheim, Ph.D. Tatiana Bronich, Ph.D.	Compositions for Modulated Release of Proteins and Methods of Use Thereof
2015	Michael Wadman, M.D., F.A.S.E.P. Thang Nguyen, M.S.N., A.P.R.N., F.N.P.-C.	Emergency Medicine Care Portfolio: Wound Irrigation System & Oral Airway Management
2014	Jason MacTaggart, M.D.	Orthogonal AquaBlade
2013	Keshore Bidasee, Ph.D.	Targeted Glyoxalase-I Gene Transfer to Prevent Cardiovascular and End-Organ Complications in Diabetes
2012	Gregory Oakley, Ph.D.	Small Molecule in Vivo Inhibitors of the N-Terminal Protein Interacting Domain of RPAI
2011	Babu Padanilam, Ph.D.	Novel Target for the Treatment of Renal Fibrosis
2010	Stephen Bonasera, M.D., Ph.D.	Noninvasive Monitoring of Functional Behaviors in Ambulatory Human Populations
2009	Paul Dunman, Ph.D.	Novel Antibiotic Compounds
2008*	Guangshun (Gus) Wang, Ph.D.	Anti-HIV Peptides and Methods of Use Thereof
2008*	Janina Baranowska-Kortylewicz, Ph.D.	Sex Hormone Binding Globulin: New Target for Cancer Therapy

*Note: Most promising new invention award was shared in 2008

Special Awards		
2017	Donny Suh, M.D.	Emerging Inventor
2016	Irving Zucker, Ph.D.	Innovator of the Year
2015	Tammy Kielian, Ph.D.	Innovator of the Year
2014	Marius Florescu, M.D.	Emerging Inventor
2013	Howard Gendelman, M.D.	Innovator of the Year
2012	Tammy Kielian, Ph.D.	Emerging Inventor
2011	Jonathan Vennerstrom, Ph.D.	Lifetime Achievement
2010	Amarnath Natarajan, Ph.D.	Emerging Inventor
2009	Rodney Markin, M.D., Ph.D.	Lifetime Achievement
2008	Dong Wang, Ph.D.	Emerging Inventor
2007	Robert LeVeen, M.D.	Lifetime Achievement

U.S. Patents

List of all U.S. patents issued to UNMC & UNO personnel during the fiscal year ending in 2018. Info includes patent numbers, patent titles, the date the patent was issued and the names of all co-inventors listed on the patent.

"Small Molecule RNASE Inhibitors and Methods of Use"

U.S. Patent No. 9,693,999 — issued July 4, 2017

■ Paul Dunman
■ Patrick Olson
■ Wayne Childers

"Shielding Device and Method"

U.S. Patent No. 9,697,920 — issued July 4, 2017

■ Gregory Gordon
■ Douglas Scott Wahnschaffe

"Methods, Systems, and Devices Related to Robotic Surgical Devices, End Effectors and Controllers"

U.S. Patent No. 9,743,987 — issued August 29, 2017

■ Shane Farritor
■ Tom Frederick
■ Joe Bartels
■ Eric Markvicka
■ Jack Mondry

"Methods, Systems, and Devices Relating to Surgical End Effectors"

U.S. Patent No. 9,757,187 — issued September 12, 2017

■ Shane Farritor
■ Tom Frederick
■ Joe Bartels

"Robotic Surgical Devices, Systems, and Related Methods"

U.S. Patent No. 9,770,305 — issued September 26, 2017

■ Shane Farritor
■ Philip Chu
■ Jason Dumpert
■ Nishant Kumar
■ Erik Mumm
■ Yutaka Tsutano

"Hemodialysis Catheter With Displaceable Lumens To Disrupt A Fibrous Sheet"

U.S. Patent No. 9,775,941 — issued October 3, 2017

■ Marius Florescu

"Fluid Jet Arterial Surgical Device"

U.S. Patent No. 9,782,195 — issued October 10, 2017

■ Alexey Kamenskiy
■ Jason MacTaggart
■ Amy Mantz
■ Nicholas Phillips

"Methods and Compositions for Inhibiting Diseases of the Central Nervous System"

U.S. Patent No. 9,782,464 — issued October 10, 2017

■ Howard Gendelman
■ R. Lee Mosley
■ Ashley Reynolds Helseth

"Compositions and Methods for Gene Therapy"

U.S. Patent No. 9,789,205 — issued October 17, 2017

■ Elena Batrakova
■ Matthew Haney
■ Alexander Kabanov
■ Vivek Mahajan

"Compositions and Methods for the Delivery of Therapeutics"

U.S. Patent No. 9,808,428 — issued November 7, 2017

■ Howard Gendelman
■ Xinming Liu

"Creatine Ester Anti-Inflammatory Compounds and Formulations"

U.S. Patent No. 9,833,427 — issued December 5, 2017

■ Thomas McDonald
■ Samuel Augustine
■ Donald Miller
■ Dennis Robinson
■ Jon Wagner

"Cancer Biomarkers and Methods of Use Thereof"

U.S. Patent No. 9,850,313 — issued December 26, 2017

■ Vimla Band
■ Hamid Band
■ Sameer Mirza

"Multifunctional Operational Component for Robotic Devices"

U.S. Patent No. 9,883,391 — issued February 6, 2018

■ Shane Farritor
■ Amy Lehman
■ Mark Rentschler

"Methods, Systems and Devices Relating to Force Control Surgical Systems"

U.S. Patent No. 9,888,966 — issued February 13, 2018

■ Shane Farritor
■ Tom Frederick
■ Joe Bartels
■ Jacob Greenburg
■ Kearney Lackas

"System and Method for Monitoring Pleural Fluid"

U.S. Patent No. 9,888,870 — issued February 13, 2018

■ Dimitrios Miserlis
■ Max Twedt
■ Kim Cluff
■ Suzanne Higgins
■ Abby Kelly

"Analogues of C5a and Methods of Using Same"

U.S. Patent No. 9,895,411 — issued February 20, 2018

■ Tammy Kielian
■ Sam Sanderson
■ Kelly Doran
■ Mark Hanke
■ Edward Morgan
■ Joy Phillips
■ Tamsin Sheen
■ Marilyn Thoman
■ Libby Virts

"Methods, Systems and Devices for Surgical Access and Procedures"

U.S. Patent No. 9,956,043 — issued May 1, 2018

■ Shane Farritor
■ Amy Lehman
■ Jeff Andrew Hawks
■ Stephen Platt
■ Mark Rentschler

"Methods for Administration and Methods for Treating Cardiovascular Diseases with Resiniferatoxin"

U.S. Patent No. 9,956,166 — issued May 1, 2018

■ Hanjun Wang
■ Irving Zucker

"Creative Oral Supplementation Using Creatine Hydrochloride Salt"

U.S. Patent No. 9,962,352 — issued May 8, 2018

■ Jonathan Vennerstrom
■ Donald Miller
■ Mark Faulkner

"Survival Predictor For Diffuse Large B Cell Lymphoma"

U.S. Patent No. 9,970,059 — issued May 15, 2018

■ Lisa Rimsza
■ Andrew T. Lister
■ Wing (John) Chan
■ Dennis Weisenburger
■ Jan Delabie
■ Erlend B. Smeland
■ Harald Holte
■ Stein Kvaloy
■ Rita M. Brazier
■ Richard I. Fisher
■ Pedro Jares
■ Armando Lopez-Guillermo
■ Elias Campo Guerri
■ Elaine S. Jaffe
■ Georg Lenz
■ Wyndham H. Wilson
■ George Wright
■ Sandeep S. Dave
■ Louis M. Staudt
■ Randy D. Gascoyne
■ Joseph M. Connors
■ Hans-Konrad Muller-Hermelink
■ Andreas Rosenwald
■ German Ott

"Protein-poly (2-oxazoline) Conjugates for Enhanced Cellular Delivery and Transport Across Biological Barriers"

U.S. Patent No. 9,974,866 — issued May 22, 2018

■ Alexander Kabanov
■ Jing Tong



New Invention Notifications

Core Metrics

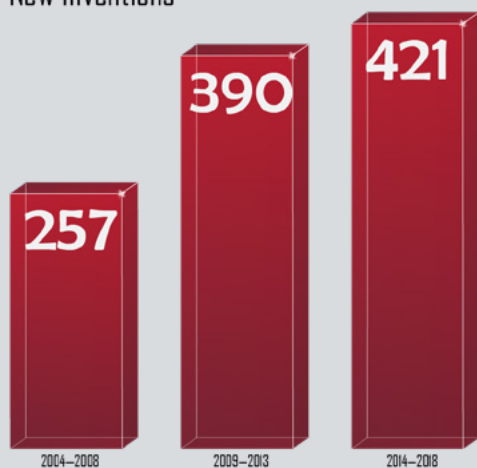
- 111 New Inventions
- 149 Unique Inventors
- 99 New Inventors



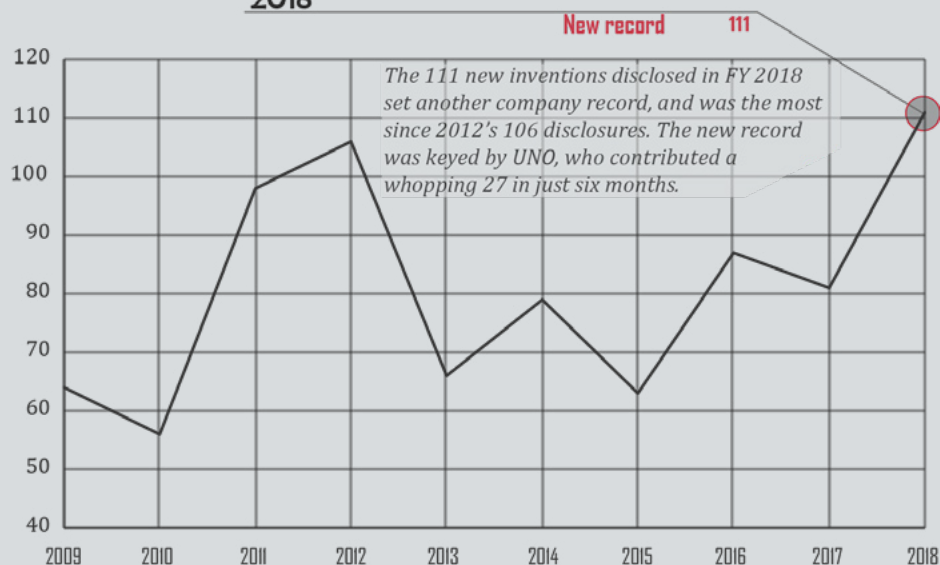
UNO Inventions

The University of Nebraska at Omaha hit the ground running once it entered a new service agreement that made UNeMed its exclusive tech transfer office. In about six months, UNO inventors flooded UNeMed with 27 new invention notifications. In the previous five years, UNO never exceeded five submissions to UNeMed.

New Inventions

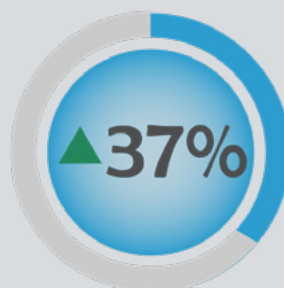


2018



Inventions

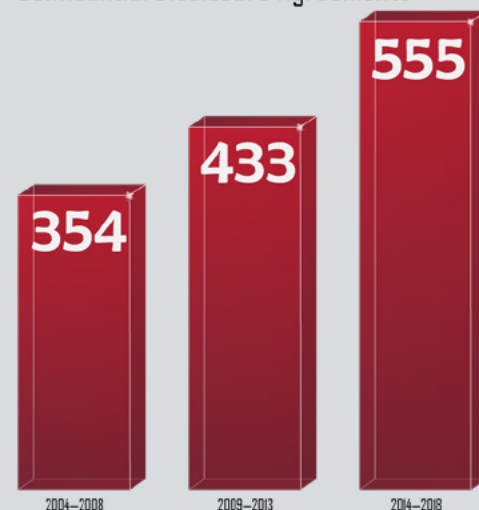
UNMC and UNO disclosed 111 new inventions in the fiscal year ending in 2018 — a new UNeMed record and a 37 percent increase over last year's 81. The previous record of 106 dates back to 2012 and was the only other year to exceed 98 new inventions.



Core Metrics

- 357 MTAs
- 115 CDAs
- 122 Patent applications
- 42 Patents issued

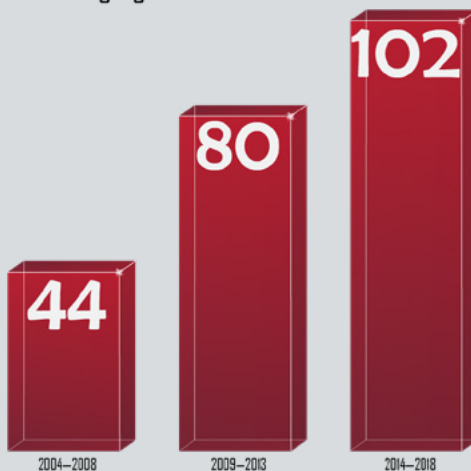
Confidential Disclosure Agreements



Core Metrics

- 141 Opportunities
- 22 Licenses
- 97 Active Licenses
- 34 Products on market
- 55 Products in dev.
- 1 Startup

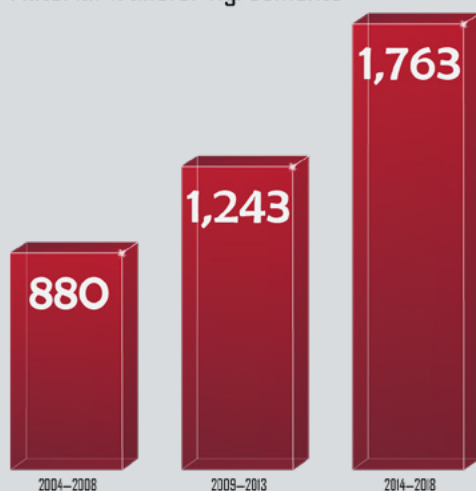
Licensing Agreements



Total Revenue



Material Transfer Agreements



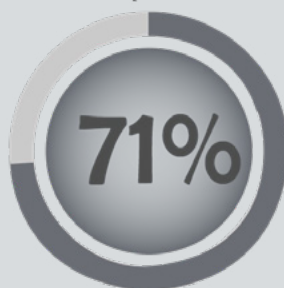
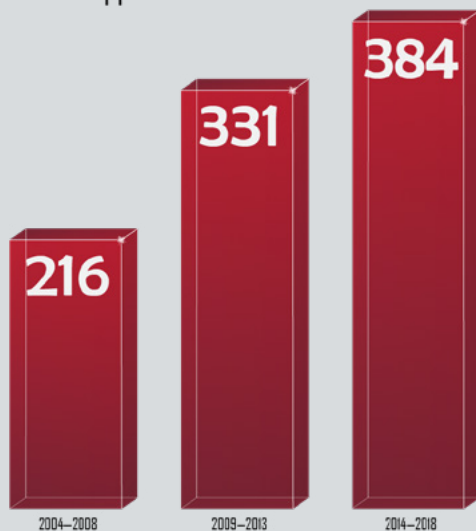
U.S. Patents

In the fiscal year ending in 2018, UNeMed secured 21 U.S. Patents for University inventors—a 31 percent increase over the 16 patents secured in 2017, and the most since a record-setting pace of 24 back in 1997. More importantly, of those 21 patents, a whopping 15 (71 percent) are licensed to industrial partners.

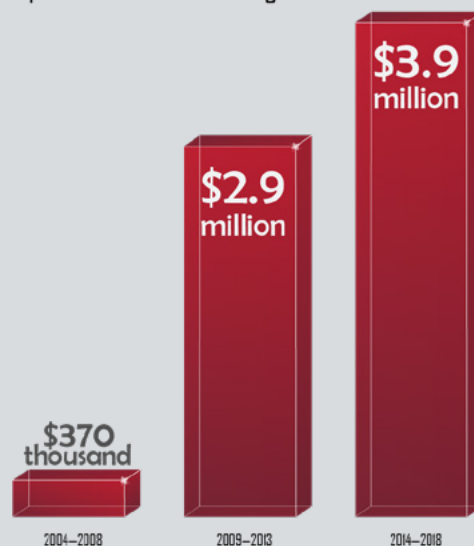
Core Metrics

\$1,501,164 Revenue
\$883,223 Sp. Research
\$185,390 Distributions

Patent Applications



Sponsored Research Agreements



Food for thought UNO capstone program can drive UNMC innovations

Nourish an invention with a robust diet of diverse thoughts and competing ideas. Go ahead.

Maybe that sounds dangerous. But diversity of thought is a super-food for those delicate innovations as they embark on what will be an absolutely brutal journey.

It's some tough love, to be sure, but do that and remarkable things can happen.

Maybe you would rather swaddle an idea in bubble wrap and wait for the phone to ring? There's a word for that. It's called neglect. All you'll likely do then is watch that idea grow old, wither and die.

It happens. It doesn't even have to be anyone's fault, either. It's just the dark side of innovation that happens everywhere. Sometimes there just isn't enough oxygen to go around.

An ER nurse, Thang Nguyen, saw it happening to one of his ideas. As one of the more innovative people at the University of Nebraska Medical Center, most of his ideas come right out of the clinic. He has a long list of better, more efficient ways to do things like washing debris from wounds and helping patients breathe.

Just like any prolific inventor, Thang finds that sometimes those ideas work and sometimes they don't. And, like too many clever ideas and better ways, sometimes they never get a real chance to fail or succeed.

It should be noted that Nguyen was the 2015 co-winner of UNeMed's Most Promising New Invention award for his contribution on a raft of ideas on which he and Michael Wadman, M.D., collaborated (page 7).

One of Nguyen's ideas—a software program to help nursing students learn the arcane art of charting patients in real time—was heading down a path toward obscurity.

TAPPING NEW RESOURCES

Thang's idea: A new way to train student nurses without risking patient safety or privacy. Medical schools don't often have a lot of resources that involve advanced coding and designing user interfaces.

Except, it turns out, they actually did: Right down the road at UNO's Peter Kiewit Institute, a seven-minute drive with bad traffic. PKI is home to the University of Nebraska Omaha's College of Information Science and Technology and the University of Nebraska-Lincoln's College of Engineering.

"There's a lot of talent here at PKI that no one at UNMC even knows about," Nguyen said.

Creating that well-balanced meal of innovation super-food is not that hard. It turns out, the first, most important step is just getting the right people in the same room. What Nguyen really needed wasn't another person in healthcare. What he needed was someone completely removed from healthcare. He needed a software engineer.

They have those in spades at UNO's College of Information



Sachin Pawaskar, Ph.D., leader of UNO's IS&T Capstone program, addresses the gathering following his team's WeChart presentation on June 1, 2018.

CAPSTONE *continues on next page*

Capstone *Continued from previous page*

and Science Technology, or IS&T for short. They also make some serious hay with a capstone program where IS&T grad students develop concepts and ideas into actual things. Working prototypes ready for full-scale testing and, in some cases, widespread use.

Nguyen's idea, called WeChart, lay dormant for four years. Then it joined the capstone program.

Working with UNO, Nguyen said he got more "accomplished in one semester than we did in the previous four years."

It took a full academic year and two teams of students, but Nguyen now has a final product that, once upon a time, only lived in his imagination. It now lives in the real world.

And it will be used in the real world. UNMC's emergency medicine department will train their student nurses with it. If all goes well, we might see other teaching hospitals and medical schools adopt the charting training program.

That's great. Wonderful, in fact.

THE BIGGER PICTURE

The University of Nebraska—and other similar institutions, if they're paying attention—should be excited about a more important prototype. I'm talking about the relationship forged between two disparate departments and two wildly different campuses.

"Medical people think one way," Nguyen said, "a software engineer thinks one way...We should not forget that we are there to solve one central problem even if there are multiple ways of looking at it."

For Nguyen, the "problem" of the hour was too-common charting errors from inexperienced and poorly trained young nurses. His WeChart application is one solution. We'll find out real soon if that solution works like we all hope it does.

But there are bigger problems. Unknown problems. Problems the University of Nebraska can identify and solve, if the right people can get together.

"Why can't we be a powerhouse," asked the capstone program leader, Sachin Pawaskar, Ph.D., a research technology fellow at IS&T. "I think we have that potential."

Sachin Pawaskar, leader of UNO's IS&T Capstone program, addresses the gathering following his team's WeChart presentation on June 1, 2018.

Pawaskar, who also holds an MBA, made it clear the WeChart project was critically important for the capstone program. He wanted a "showcase of what a successful partnership and relationship could be."

That showcase will be on full display on campus at UNMC in the coming semesters as young nursing students put WeChart through the paces.

Nguyen's idea will finally get the chance to sink or swim on its own merits, which is all anyone can really ask.

But more than that, UNMC and UNO now have a buffet line that can fuel some innovative ideas across a treacherous divide—the chasm between the sketch of a promising concept and a final product that actually makes life better.

"I really think that the healthcare area is just set up for an IT revolution," Pawaskar said shortly after his students presented their WeChat project to Nguyen and dozens of others. Pawaskar added: "I really feel that healthcare can be totally revolutionized if we can incorporate IT at the right places at the right levels...It's not any silver bullet, but there's so many things you can do."

Nguyen nodded: "And the best part? All the pieces are already here."

Suh precision injection syringe

New syringe allows precise, one-handed injections



RUNDOWN

- *Can be securely operated with one hand*
- *Allows use of a precise, pencil-grip*
- *Designed with feedback from several clinical specialties*
- *Potential applications in ophthalmology, ear-nose-throat, plastic surgery, pediatric surgery, rheumatology and self-injections*
- *Also allows traditional syringe use*

A novel syringe developed at the University of Nebraska Medical Center enables users to safely perform one-handed injections with improved control. The new syringe is particularly useful in several delicate medical procedures, like correcting crossed or lazy eyes in children. The syringe frees up the other hand to safely secure the injection site, allowing doctors even more precision.

Led by UNeMed's 2017 Innovator of the Year, pediatric ophthalmologist Donny Suh, M.D., the inventors gathered hands-on feedback from a wide range of clinical specialists to create an elegant working prototype. While the design facilitates the comfortable operation of the syringe with one hand, it can still be used as a traditional syringe.

This technology has potential applications in ophthalmology, ear-nose-throat, rheumatology, plastic surgery, and self-injections, among others. Currently, there is strong clinical interest in using this syringe for the delicate delivery of therapeutics for the treatment of acute macular degeneration.

We are now working with a manufacturing partner to develop a final working prototype for regulatory testing and approval.

EASI-CRISPR

Get more out of CRISPR with new insertion protocol

The discovery of the new gene editing technology, CRISPR, was a dream come true for scientists everywhere. Never before could DNA be cut so cleanly and precisely. But CRISPR only solves half the problem.

While CRISPR can delete a specific segment of mutated or faulty DNA, the process for replacing that piece has been unwieldy, imprecise and very inefficient. In short, CRISPR is the precision of a laser, while current DNA insertion methods are closer to bludgeons.

An international collaboration invented a better method to capitalize on CRISPR's strengths, while dramatically improving efficiency of inserting new material by as much as 400 percent. The University of Nebraska Medical Center's Dr. Channabasavaiah Gurumurthy and Drs. Masato Ohtsuka and Hiromi Miura at the Tokai University School of Medicine in Japan invented the protocol, which has a remarkably high rate of efficiency (up to 100 percent in some genetic loci).

As a research tool, the new protocol could have a profound impact in developing new genetically engineered model organisms, including animals, cells and plants, and other testing media that could lead to future cures of genetic conditions.

RUNDOWN

- Insert larger DNA fragments
- Improve efficiency up to 83 percent
- No special equipment needed

Antimicrobial peptides

Imbue orthopedic implants with primary immunity

Orthopedic implants, such as hip or knee replacements, all eventually fail due to wear and tear. But if an implant gets infected it fails much more rapidly and can even lead to death.

Researchers at the University of Nebraska Medical Center discovered a new way to prevent implant-associated biofilm infections. Guangshun Wang, Ph.D., designed antimicrobial peptides to coat the surface of metallic orthopedic implants and specifically target antibiotic resistant infections known as MRSA or methicillin-resistant *Staphylococcus aureus*. Not only do the novel proteins prevent MRSA biofilm formation, but they also recruit host immune cells to help clear any opportunistic bacteria.

By adding these peptides to an implant's surface, Dr. Wang's technology effectively imbues the medical device with its own innate immunity. In humans, innate immunity represents the front line defense against pathogens. Implants, however, have no such basic protections against infections, including MRSA, which accounts for two-thirds of all orthopedic implant infections. Implants can become unchecked breeding grounds for biofilm infections and ultimately lead to total device replacement—at best.

More than one million Americans receive hip or knee replacements each year. While about 90 percent of those procedures are still effective 10 years later, that means approximately 100,000 patients will undergo a repeat procedure to alleviate pain associated with prosthetic loosening or bacterial infection.

As an opportunistic pathogen, MRSA has evolved numerous strategies for evading the human immune system. MRSA has a particularly notorious ability to find, attach to, and create bacterial biofilms on orthopedic implants. Once a MRSA biofilm is fully formed, the only effective treatment involves total removal of the orthopedic implant. Even then, the patient is at a permanently increased risk for repeat infection.

RUNDOWN

- Highly effective against leading causes of orthopedic infections including MRSA
- Ability to prevent bacterial biofilm formation; Formulated for immobilization onto metal surfaces
- Evidence of innate immune cell recruitment



AV fistulas

Device helps fistulas mature faster, better, safer



Healthcare providers now have a better, more reliable way to improve dialysis in patients with kidney failure.

Hemodialysis simulates kidneys function by filtering a patient's blood outside the body to cleanse it from toxins. For dialysis to work properly, dialysis machines must filter as much blood as possible during each treatment.

An arteriovenous or AV fistula is a point of entry and exit to the blood vessels that also allows large amounts of blood to flow uninterrupted. This portal serves as a connection between an artery and a vein in the patient's arm and allows the vein to grow large and strong providing reliable access to blood vessels each time.

AV fistulas are a complex and imperfect solution, even when performed by an expert team of surgeons and support staff.

The problem with creating AV fistulas is that they require weeks to months to develop, or mature, and strengthen before a patient can undergo hemodialysis. Many patients undergoing dialysis are never able to mature a large fistula.

A better, more reliable way to create AV fistulas seems like a good idea.

UNMC surgeon and the 2014 Emerging Inventor awardee, Marius Florescu, M.D., has a new device that represents the first major improvement for the AV fistula in more than 40 years. His device promotes better AV fistula creation and maturation for hemodialysis.

Dr. Florescu also made a critical discovery during his proof-of-concept work: Identifying the first known animal model in which AV fistulas can mature.

Inventor Marius Florescu, M.D., describes his fistula maturation device to UNeMed staffers in November 2014.

RUNDOWN

- First major improvement for the AV fistula in more than 40 years
- Medical device that promotes fistula maturation
- Capable of maturing AV fistulas in an animal model
- Inexpensive, single use
- Multiple applications beyond fistula maturation

Microtubule targeting

New compounds allow imaging, treatment of cancer

RUNDOWN

- Microtubule-targeted radiopharmaceuticals
- Images and treats cancer
- Non-radioactive forms of the drugs can induce cell death
- Can be labeled with a variety of radionuclides

UNMC researchers have developed compounds that are capable of not only imaging and monitoring tumors, but treating them as well.

The new compounds specifically bind to protein-based structures called microtubules. Microtubules play a critical role in a number of cellular functions, and are a key target for treating a variety of cancers.

UNMC's compounds selectively target microtubules. The compounds can be safely labeled with various radioactive atoms that allow the compounds to be used for imaging (SPECT or PET) and therapy. When used without the radioactive isotopes, the compounds can help kill cancer cells and make them more susceptible to radiation therapy.

Microtubule-targeted compounds labeled with iodine-131 were tested in a mouse model of glioblastoma. Treatment with the compound significantly reduced tumor size and weight. Additional studies will look at the use of other radionuclides such as astatine-211.

Parkinson's vaccine Novel combination clears first clinical trial

A novel combination developed by researchers at the University of Nebraska Medical Center may be the final solution that could deliver a knockout blow to Parkinson's disease.

Howard Gendelman, M.D., UNeMed's 2013 Innovator of the Year, and his team believe they are on the verge of producing an effective vaccine to battle the debilitating disorder that affects more than 1 million Americans. Right now, the only treatment options for Parkinson's—the world's second-leading neurodegenerative disorder behind Alzheimer's—are methods for reducing symptoms.

But if Gendelman's approach succeeds, the immune systems of vaccinated patients will be armed to fend off the disease and prevent its disastrous effects.

The vaccine turns an old foe into a potential ally.

Vaccination with a protein, alpha-synuclein, alone actually has the ability to make Parkinson's even worse. But when the protein is paired with an immune modulator, it promotes an immune response that protects brain cells from further damage.

Preclinical studies show a remarkable 91 percent survival rate of neurons in treated laboratory mice.

Dr. Gendelman's team recently completed a small clinical trial in Parkinson's patients testing one of the vaccine's potential components—an immune modulating drug. Treatment with the drug transformed the immune response to a more neuroprotective immune response and also showed clinical signs of improvement in the patients.

RUNDOWN

- Novel therapeutic combination
- Treats underlying factors, not just symptoms
- Treats existing disease
- Prevents future disease
- Potentially useful for other neurodegenerative disorders

AquaBlade Eliminate risks associated with open-heart surgeries

AquaBlade, a new medical device invented at the University of Nebraska Medical Center and UNeMed's Most Promising New Invention of 2014, could provide a less invasive treatment for cardiovascular disease and eliminate a significant amount of the inherent risks associated with open-heart surgeries.

AquaBlade is an innovative surgical instrument that uses a catheter to deliver a specialized cutting tool through a patient's artery where it uses a high-pressure water jet to help repair life-threatening tears in artery walls. The device could also be used to help remove previously deployed stents.

Arterial tears in the inner lining of an artery can lead to the formation of blood clots that obstruct blood flow and eventually lead to a heart attack or stroke. If left untreated, an arterial tear is fatal for 80 percent of patients.

Current treatments for arterial tears often require open-heart surgery, which carries a 25 percent risk of death and an extended recovery period.

AquaBlade eliminates most of those risks while also minimizing the time of recovery. It is currently at the conceptual stage, preparing a functional prototype for preclinical testing.



RUNDOWN

- Treats aortic dissection
- Removes stents
- Less invasive
- Faster patient recovery

COPD Monitoring Platform Wearable device warns of worsening COPD symptoms...before they happen

Chronic obstructive pulmonary disorder, or COPD, is one of the largest and fastest growing causes of death in the world.

People that live with COPD suffer chronic breathlessness and the risk of exacerbations: A sudden worsening of symptoms. Exacerbations are deadly, and are often only treatable in the intensive care unit.

A new invention from the University of Nebraska warns people with COPD about worsening symptoms, before they happen.

The device monitors the synchronization between breathing and walking. In laboratory studies, patients with COPD

were less able to synchronize their breathing and walking. The worse the disease got, the worse their ability to synchronize.

Initial results from a national clinical study matched laboratory results. The inventors are currently working to further refine the device and improve the analysis.

For the first time ever, a wearable device has the potential to predict the worsening of COPD symptoms, even exacerbations. Early detection opens the door to new treatment protocols focused on preventing worsening symptoms, exacerbations and costly hospitalizations.

Cyborg Arm

Wirelessly controlled motors enhance functionality and prevent muscle fatigue

A new cyborg prosthetic arm design brings prosthetics one step closer to replicating anatomy.

Traditional electronically-powered prostheses have two common downfalls: weight and a lack of manual, body-powered

control.

To solve these issues, a research team at UNO Biomechanics designed a novel prosthetic arm that incorporates the best of both worlds: It has both the lightweight feel of a body-powered prosthetic and the improved

functionality of an electronically-powered device.

Using a body-powered prosthetic base, the hybrid arm still provides manual control. Manual motor control is an important feature because it permits the development of healthy and strong muscles in children who would normally abandon the use of their affected limb. That leads to long-term weakness and even postural problems such as scoliosis.

To reduce weight and enhance ease of use, fewer (and lighter-weight) motors are used. Rather than developing all of the force needed to grip objects, the motors in this hybrid design are intended to augment the user's strength to make using the prosthetic easier and to encourage them to use the strength they have.



RUNDOWN

- *Lightweight, ergonomic*
- *Grip primarily controlled by elbow or shoulder flexion*
- *Grip strength enhanced or even maintained by wirelessly controlled motors*
- *Reduces muscle fatigue*
- *Increases functionality*

Antiretroviral therapy

New delivery method opens powerful option for HIV treatment

Early studies show UNMC's novel approach to HIV treatment could reduce the regimen to a single treatment once every month, eliminating the need for current strategies that require daily administration of medicine.

Antiretroviral therapies, or ART, are also ineffective at reaching viral reservoirs in the lymph nodes and the central nervous system. Reservoirs like these essentially serve as a bunkers that shelter HIV from medication.

UNMC researchers overcame this obstacle with a new nanoformulation called LASER ART.

LASER ART harnesses the power of the patient's immune system to store and deliver ART medications throughout the entire body in a sustained release formulation.

LASER ART piggybacks on macrophages, which have full access to all parts of the body, including the central nervous system—a particularly difficult system to

hack for most modern medicines.

Early tests on mouse models and large animals show that LASER ART produces a sustained release with long-lasting antiretroviral activity.

With further development LASER ART could have a dramatic impact on the estimated 34.2 million people on the planet who are affected by HIV. The Centers for Disease Control estimates 1.1 million Americans are living with HIV infection.



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