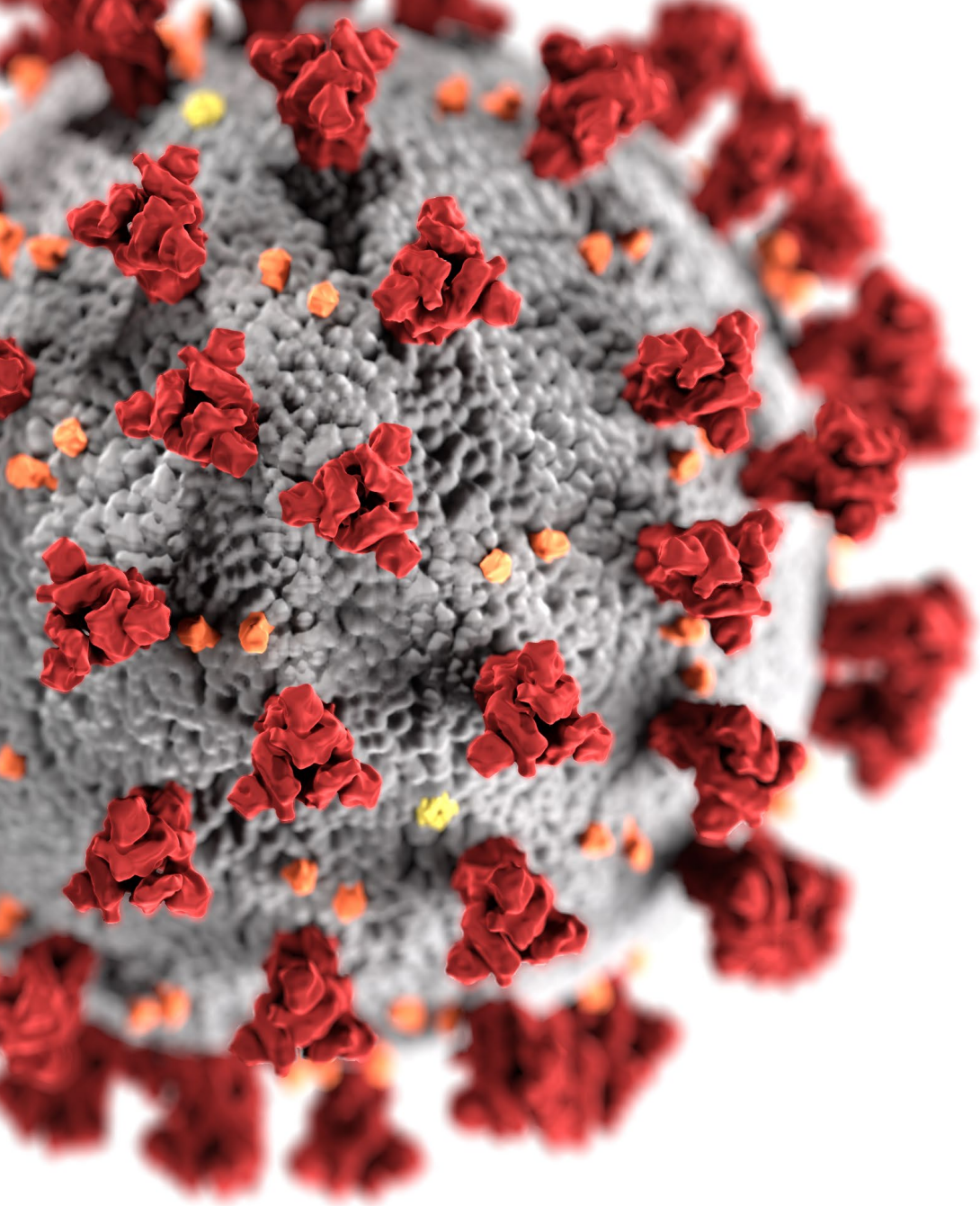

UNeMed

2020 ANNUAL REPORT

unemed

tech transfer for nebraska

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986099 Nebraska Medical Center,
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On the cover:
This illustration, created at the Centers for Disease Control and Prevention, reveals ultrastructural morphology exhibited by coronaviruses. Note the spikes that adorn the outer surface of the virus, which impart the look of a corona surrounding the virion, when viewed electron microscopically. A novel coronavirus, named Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2), was identified as the cause of an outbreak of respiratory illness first detected in Wuhan, China in 2019. The illness caused by this virus has been named coronavirus disease 2019, or COVID-19 for short.

INSIDE

Message from the President & CEO

I think every 2020 annual report will start with the phrase, "It has been an unusual year." On second thought, "unusual" would be a contender as the biggest understatement of the year.

We were about midway through the fiscal year when the COVID-19 pandemic shut down most of everything.

Obviously, our concern at the time was for the health and safety of all our friends and colleagues here and everywhere. We took it for granted that all our plans, our metrics and things like annual goals would ultimately fail or fall apart.

We canceled our hugely successful MidWest Drug Development Conference and we are still not sure if we can bring it back in 2021 despite all our hopes and ambitions to do so. The 2020 Innovation Awards is a virtual event, and it's hard to imagine when we can safely bring people together in the same room, which is so much a part of what we do.

In short, our most basic expectations dramatically changed. We began the year concerned with little else than translating cutting-edge science into solutions for a marketplace that needs new ideas and discoveries to help more people realize healthier lives. By the end of April, our concerns appeared to be more appropriately focused on plain survival than anything else.

But the truth is, we didn't have as much time as you'd think for things like worrying about the pandemic.

From the beginning of the outbreak, inventors at the University of Nebraska turned their ingenuity on the novel coronavirus responsible for the pandemic. The result was a flurry of innovation that not only kept our staff as busy as ever, but helped thousands across this planet fight COVID-19.

Never has my faith and pride in the University of Nebraska's leadership, expertise and innovative spirit been more resolute. The University's organized response to this pandemic—and the incredible innovation that resulted from it—was amazing to witness.

In the last six months of the fiscal year ending in 2020, inventors at the University of Nebraska Medical Center and the University of Nebraska at Omaha produced a string of new inventions at a clip we've never seen before.

That is no exaggeration.

Since UNeMed's creation in 1991, there has not been a more productive six-month stretch than the last six months of 2020. This was a time when most

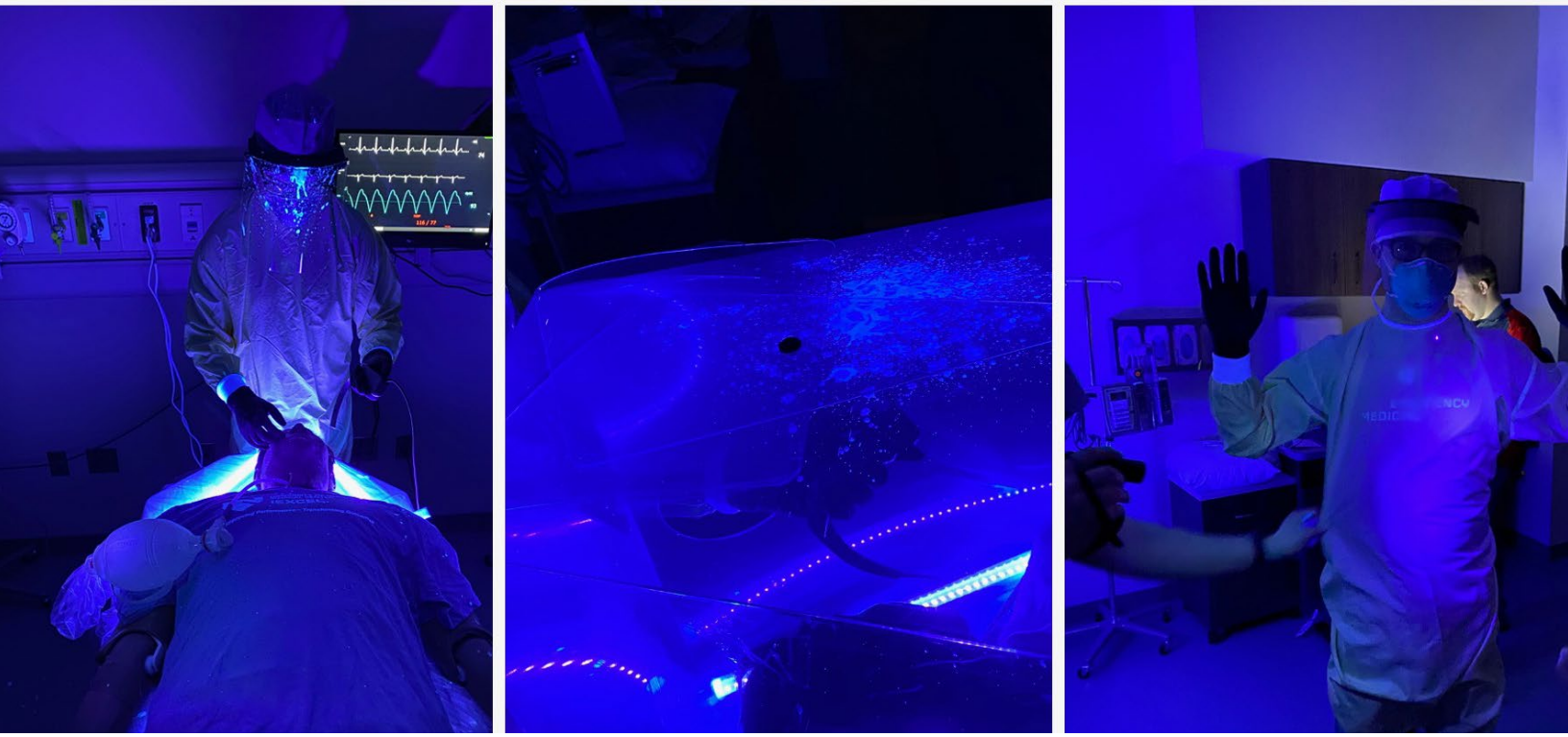
***LETTER** continues on page 4*

Michael Dixon, Ph.D.
President and CEO

COVID-19 Innovations

A look at the 28 inventions that UNMC and UNO inventors submitted in response to the COVID-19 pandemic during the ficsal year ending in 2020. Listed below are the name of the technology, followed by a list of contributing inventors on the project.

3D Printed Nasopharyngeal Swab (JC Swab)	*Jesse Cox*
Ceramic Air Filter	*James Linder*
Cough Collector	*David Brett-Major, Mara Jana Broadhurst, James Lawler, John-Martin Lowe, Joshua Santarpia*
COVID19 Screener	*Thang Nguyen, Michael Wadman, Wesley Zeger*
Lung Derived Extracelluar Vesicles	*Gurudutt Pendyala, Sowmya Yelamanchili*
Genetically Engineered Mouse Models (GEMs) to Help Fight COVID-19	*Channabasavaiah Gurumurthy, Rolen Quadros*
Hand Guard Slit Lamp Shield	*Rao Chundury*
Home Specimen Collection Kit for Viral Panels	*Thang Nguyen, Michael Wadman, Wesley Zeger*
Infectious Aerosol Capture Device	*Steven Lisco, Nicholas Markin, James Linder*
Infectious Aerosol Capture Device Adapter	*Steven Lisco, Nicholas Markin*
Infectious Aerosol Capture Device Filter Housing	*Steven Lisco, Nicholas Markin, James Linder*
Infectious Aerosol Capture Mask (IACM) Single Piece Design	*Steven Lisco, Nicholas Markin*
Intubation Box	*Michael Ash, Thomas Schulte*
Intubation Box Vacuum Adaption	*James Linder*
KeepAway	*Michael Mazgaj*
Magnetic Face Shield	*Thang Nguyen*
Method of Fabricating Nanofiber Swabs	*Jingwei Xie, Mark Carlson, Shixuan Chen*
Modular Electronic Decision Support Builder	*Ellen Kerns, Russel McCulloh*
Modular Vaccine Platform	*Yuri Lyubchenko, Karen Zagorski*
Naso/Oropharyngeal Swab Specimen Trainer	*Christie Barnes, Jayme Dowdall, Samuel Pate, Benjamin Stobbe*
Prodrug Formulations	*Benson Edagwa, Howard Gendelman, St Patrick Reid*
PAPR Adapter	*Nicholas Markin, Jerald Farke*
Portable Negative Air Pressure Patient Room	*Mara Jana Broadhurst, James Linder*
Real-Time Reverse Transcription PCR Assay for 2019-nCoV	*Mara Jana Broadhurst, Hannah Creager, Paul Fey, Luke Handke*
SARS-CoV-2 Antigen Design, Production and Testing	*Ken Bayles, Gloria Borgstahl, Siddappa Byrareddy, Chittibabu Guda, St Patrick Reid*
Therapeutic Impact of Digoxin on COVID-19 Induced Pathophysiology	*Surendra Shukla*
Transesophageal Echocardiography Probe Clean Sheath	*Nicholas Markin*
Z Filter Device	*Thang Nguyen, Heather Nichols, Michael Wadman, Wesley Zeger*



Tests carried out at UNMC and Nebraska Medicine show the potential danger for clinical staff during intubation procedures (far left), where a physician inserts a tube in a patient's throat to help them breathe. UNMC staff used this information to develop a low-cost and lightweight "intubation shield" (center) that adds another layer of protection for healthcare workers from potential contamination of viral agents, including SARS-CoV-2, the novel coronavirus responsible for COVID-19, as demonstrated at far right.

LETTER *Continued from page two*

people were self-quarantined at home, avoiding human interactions at every turn, only attending virtual events and perhaps streaming a little too much TV.

But UNMC and UNO inventors still produced 73 new inventions during that time, 28 of which were directly related to the COVID-19 pandemic.

Those COVID inventions filled the spectrum of creativity, from clever solutions to overcoming breakdowns in medical supply chains, to more cost-effective solutions for personal protective equipment, to new ways of testing and treating viral infections.

The activity was nothing short of inspiring.

I say that because in addition to those 73 new inventions, there were also UNMC and Nebraska Medicine contributions that added to the world's basic understanding of the novel coronavirus and COVID-19. UNMC and it's clinical partner, Nebraska Medicine, found new ways to safely reuse things like masks and gloves; they orchestrated critical drug trials for potential treatments, namely Remdesivir; they set the example for healthcare providers everywhere on the best policies and practices of confronting the pandemic.

Within weeks there were scores of new research projects examining every aspect of this virus. As those experiments continue, the University of Nebraska will no doubt contribute even more to the world's understanding of how this virus works…and how to fight it more effectively.

While we are very proud of all our accomplishments this year, it is hard to hold them above what so many of our faculty and staff have done during these most challenging times.

Their dedication inspired us to work that much harder; to help those innovations get to where they're most desperately needed—Out there, in the world, not just in a publication or presentation.

For example, with 105 new innovations this last year (third most in our history), we created a record 169 opportunities for those innovations. Each one of those opportunities represents interest from a company that could invest time and treasure into the additional development of those inventions.

I'm also pleased to report that we secured 23 U.S. patents in 2020, the second most since we landed 24 in 1997. But I'm most proud that 17 of those technologies have been licensed by outside companies.

After all, that's why we're here: To help protect University innovations and guide them toward public spaces where everyone can benefit.

When you do that for a place that fosters a culture of passion and creativity like the University of Nebraska, that mission is not just intensely gratifying, but an active compulsion that becomes its own reward.

So, rather than pat ourselves on the back for doing what we're supposed to do, I'd rather take this moment—on behalf of everyone at UNeMed—to thank all those at UNMC, UNO and Nebraska Medicine for all they've done in 2020 to help make this world a little bit better.

If there's one thing to take away from the year that was 2020, it should be that.

Edagwa, Hopkins headline '19 Innovation Awards

On Thursday, Oct. 17, 2019, Innovation Week concluded with the 2019 Research Innovation Awards Banquet at the Truhlsen Campus Events Center in the Michael F. Sorrell Center.

UNMC researchers Benson Edagwa, PhD, and Corey Hopkins, PhD, were presented the top honors, and highlighted the 13th installment of UNeMed's awards program. Vascular surgeon and Professor Jason Johanning, MD, was also singled out with a special award.

Sponsored and hosted by UNeMed, the awards program specifically recognizes UNMC and UNO innovators and their work, conferring awards to those who have disclosed a new invention, were issued a United States patent, or had their technology licensed for further commercial development.

The awards ceremony honored a new innovation from Dr. Hopkins as the Most Promising New Invention, and Dr. Edagwa was named the Emerging Inventor. Dr. Johnanning's FutureAssure was named UNeTech's Startup of the Year.

Benson Edagwa, PhD, (left) chats with colleagues during the 2019 Innovation Awards ceremony. Later in the evening, Dr. Edagwa was named the 2019 Emerging Inventor.

Dr. Hopkins is developing a novel series of inhibitors that hold promise as treatments for several inflammatory diseases, including chronic obstructive pulmonary disease, rheumatoid arthritis, psoriasis, atopic dermatitis and inflammatory bowel disease. His inhibitors, which target phosphodiesterase 4 or PDE4, also show promise in central nervous system diseases like schizophrenia, neurodegenerative diseases and even drug addiction.

As evidence of the technology's potential, Dr. Hopkins' inhibitors have already been licensed to an undisclosed commercial partner, who will continue developing the innovation.

Dr. Edagwa was the 2019 Emerging Inventor in recognition of his contributions to innovations in the development of long-acting antiretroviral therapies.

Since he joined UNMC in 2012, Dr. Edagwa has been an inventor on 11 inventions, including three in the last year. He is also a listed inventor on 11 pending patent applications. Most of his work centers on improvements to treating HIV and Hepatitis B, and is a key inventor of LASER ART (long acting slow effective antiretroviral therapy).

LASER ART shows great promise as a treatment that could be given to HIV patients once every six months or even just once a year. LASER ART was also a key component in a recent study led by

***AWARDS** continues on next page*

ABOVE: Jason Johanning, MD, was awarded UNeTech's Start-up of the Year for his company, FutureAssure.

AT LEFT: From left are Chancellor Jeffrey Gold, MD, Corey Hopkins, PhD, and UNeMed President and CEO, Michael Dixon, PhD. Dr. Hopkins' PDE4B Selective Inhibitors was named UNeMed's Most Promising New Invention of the year during the 2019 Innovation Awards ceremony.

AWARDS *Continued from previous page*

Howard Gendelman, MD, that appeared to eradicate HIV from mice—a scientific first.

Dr. Johanning created his startup, FutureAssure, on the foundation of a device he invented that will help measure a patient's risk in surgery. The device gives medical teams objective measures to assess that risk and eventually improve outcomes and surgical safety.

The evening also featured a keynote speaker, noted chemist Dennis Liotta, PhD. He is the Executive Director for the Emory Institute for Drug Development at Emory University, and helped transform HIV/AIDS from a death sentence into a chronic but manageable infection.

It is estimated that about 90 percent of all HIV-infected patients in the United States have taken one of the two drugs he invented.

Dr. Liotta talked about his long road toward a blockbuster drug development that spanned more than 15 years, but ultimately resulted in $525 million in royalties to Emory University in 2005.

"This looks like the bottom line. This looks like the end of the story, but it's not," Dr. Liotta said.

The money only lasts so long, and it's important to have the infrastructure of support so that large-impact developments can happen more often, he said.

Earlier in the day, at noon, Dr. Liotta hosted a well-attended seminar entitled: "Novel Therapeutics for Treating Viral Diseases, Cancer and Inflammatory Disorders." The presentation was a scientific look at his more current work, including an algorithmic system called FRESH. It uses machine learning to help discover more promising new drug candidates.

Award History

Most Promising New Invention		
2019	Corey Hopkins, MD	PDE4B Selective Inhibitors
2018	Catherine Gebhart, PhD Varun Kesharwani, PhD	Multiplex Assay for Rapid Detection of HSV1, HSV2, EBV and CMV by qPRC
2017	Jingwei Xie, PhD Shixuan Chen, PhD Mark Carlson, MD	Nanofiber Sponges for Hemostasis
2016	Joyce Solheim, PhD Tatiana Bronich, PhD	Compositions for Modulated Release of Proteins and Methods of Use Thereof
2015	Michael Wadman, MD, FASEP Thang Nguyen, MSN, APRN, FNP-C	Emergency Medicine Care Portfolio: Wound Irrigation System & Oral Airway Management
2014	Jason MacTaggart, MD	Orthagonal AquaBlade
2013	Keshore Bidasee, PhD	Targeted Glyoxalase-1 Gene Transfer to Prevent Cardiovascular and End-Organ Complications in Diabetes
2012	Gregory Oakley, PhD	Small Molecule in Vivo Inhibitors of the N-Terminal Protein Interacting Domain of RPA1
2011	Babu Padanilam, PhD	Novel Target for the Treatment of Renal Fibrosis
2010	Stephen Bonasera, MD, PhD	Noninvasive Monitoring of Functional Behaviors in Ambulatory Human Populations
2009	Paul Dunman, PhD	Novel Antibiotic Compounds
*2008	Guangshun (Gus) Wang, PhD	Anti-HIV Peptides and Methods of Use Thereof
*2008	Janina Baranowska-Kortylewicz, PhD	Sex Hormone Binding Globulin: New Target for Cancer Therapy

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

Special Awards		
2019	Benson Edagwa, PhD	Emerging Inventor
2019	FutureAssure	Startup of the Year (UNeTech)
2018	UNO Department of Biomechanics	Innovator of the Year
2018	Centese, Inc.	Startup of the Year (UNeTech)
2017	Donny Suh, MD	Emerging Inventor
2016	Irving Zucker, PhD	Innovator of the Year
2015	Tammy Kielian, PhD	Innovator of the Year
2014	Marius Florescu, MD	Emerging Inventor
2013	Howard Gendelman, MD	Innovator of the Year
2012	Tammy Kielian, PhD	Emerging Inventor
2011	Jonathan Vennerstrom, PhD	Lifetime Achievement
2010	Amarnath Natarajan, PhD	Emerging Inventor
2009	Rodney Markin, MD, PhD	Lifetime Achievement
2008	Dong Wang, PhD	Emerging Inventor
2007	Robert LeVeen, MD	Lifetime Achievement

UNeTech helps build Nebraska startups

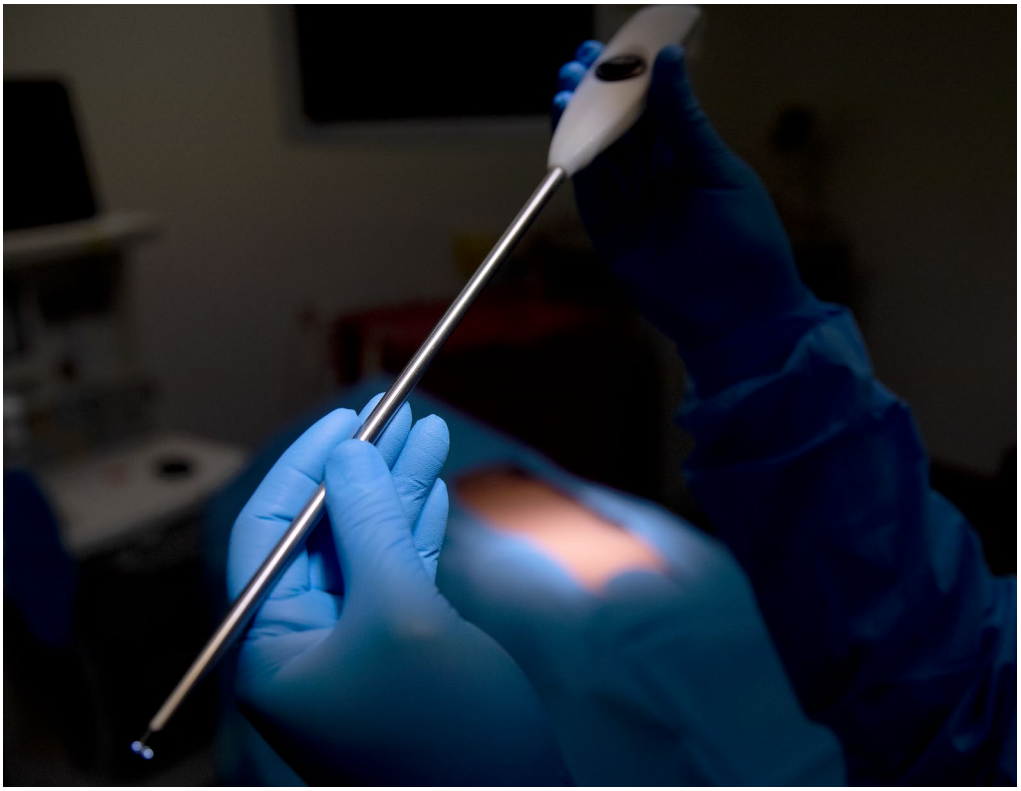
UNeTech is a state-sponsored translational research institute shared between the University of Nebraska at Omaha and the University of Nebraska Medical Center. Its primary mission is to translate cutting-edge university innovation into vital new technology startups for the benefit of all Nebraskans. UNeTech is further supported by generous grants from the United States Economic Development Administration as well as the Ewing Marion Kauffman foundation.

UNeTech works closely with UNeMed, to further develop inventions from UNO and UNMC. From prototyping services provided by Metro Community College's Center for Advanced and Emerging Technology, to entrepreneurial matchmaking from the Greater Omaha Chamber of Commerce, to in-house SBIR/STTR filings with local investors, UNeTech is the point where an entire city comes together to build the future economy.

UNeTech also extends services to the entrepreneurs throughout Nebraska and uses the world-class resources of the Omaha campuses of the University of Nebraska to invest in the state's future. UNeTech's portfolio of projects includes these UNeMed inventions:

Precision Syringe

Invented by Donny Suh, MD, and founded by Adrian Blake, the precision syringe (pictured above) is a precise, ergonomic solution to inject the right amount of medicine in the perfect place. Precision Syringe is currently applying for 510K clearance from the FDA in advance of going to market. Precision Syringe is expected to bring new products to market within the next 18 months.



Global Laparoscopy Solutions

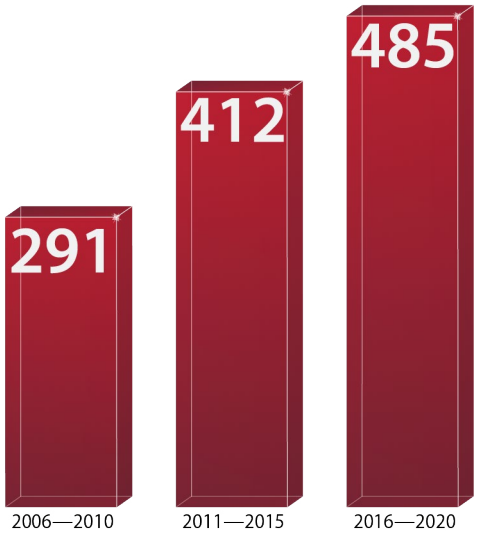
Licensee of the Portable Laparoscope (at left) invented by Srinivasa Chandra, MD, Global Laparoscopy Solutions is a globally focused surgical company. Formed in partnership with Bob Calcaterra—a decorated St. Louis entrepreneur, and sharing time between Omaha, St. Louis and Kansas City—GLS is rapidly developing a prototype of a revolutionary new surgical instrument that will bring state-of-the-art surgical care to billions.

BreezMed

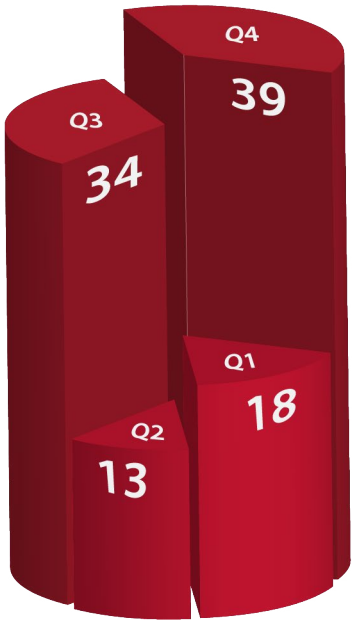
The brainchild of Stephen Salzbrenner, MD, BreezMed is a provider-oriented software solution to help patients get their prescriptions faster. By helping doctors and pharmacists navigate insurance company red tape, BreezMed is a new generation of startups confronting physician burnout with innovation. The recent awardee of a Phase I STTR grant from the National Institutes of Health, BreezMed is poised to launch a service that revolutionizes how doctors manage prior authorizations.

2020 UNeMed Metrics

New Inventions



2020 New Invention Disclosures—Quarterly



105 *Number of new inventions submitted from UNMC and UNO faculty, students and staff during the 2020 fiscal year; third-most in UNeMed's 29-year history.*

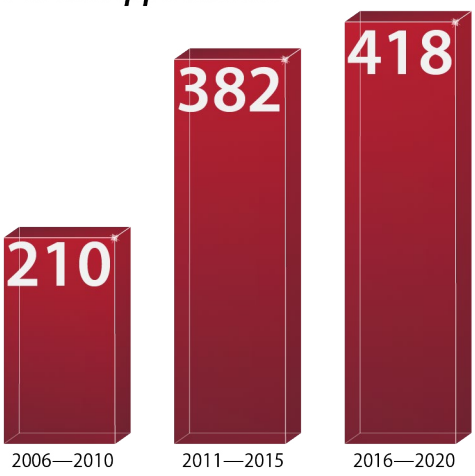
73 *Combined submissions from the third and fourth quarters of 2020, the most inventive six-month stretch in UNeMed history.*

39 *Inventions submitted during the third fiscal quarter of 2020, the second most prolific quarter in company history. The record: 42, set during 2018's fourth quarter.*

Core Metrics

105 New inventions
157 Unique inventors
85 New inventors

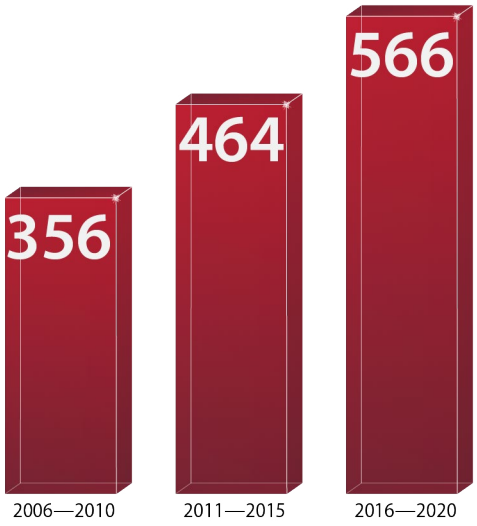
Patent Applications



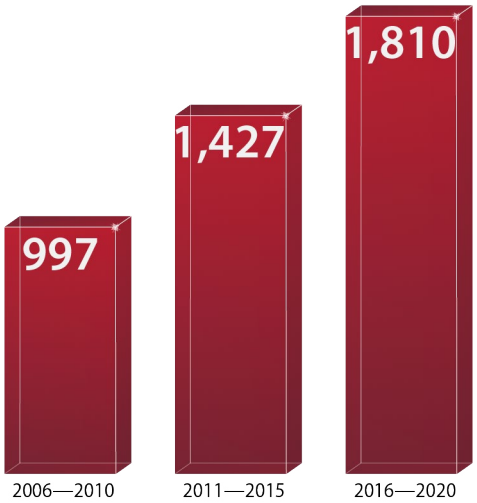
Core Metrics

352 MTAs
122 CDAs

Confidential Disclosure Agreements



Material Transfer Agreements

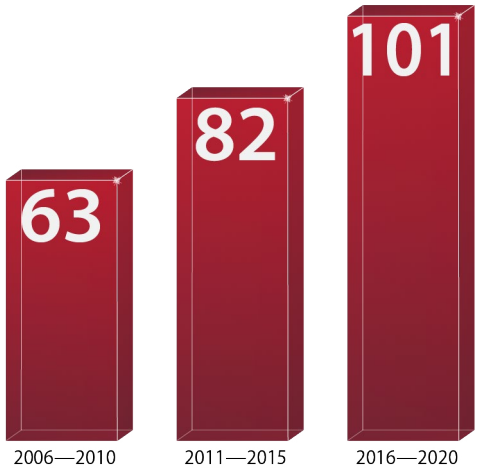


Core Metrics

155 Patent applications filed
61 Total patents issued
23 U.S. patents issued
38 Foreign patents issued

23 *U.S. Patents secured in 2020, the second most since 1997 when UNeMed landed 24. UNeMed eventually licensed 17 of the 23.*

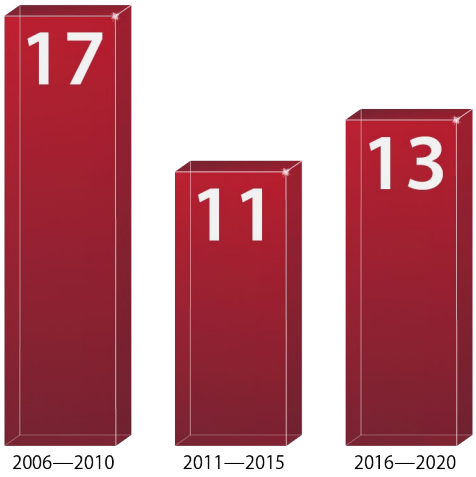
Licensing Agreements



Core Metrics

16 Licenses
107 Active licenses
40 Products on market
5 New startups

Startups

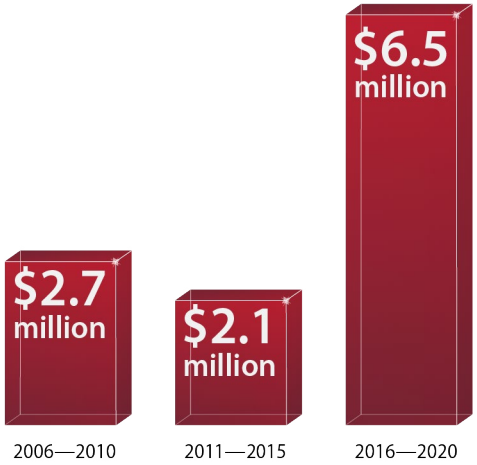


169 *Record number of opportunities, which reflect the amount of interactions that UNeMed generated with companies to review UNMC & UNO technologies.*

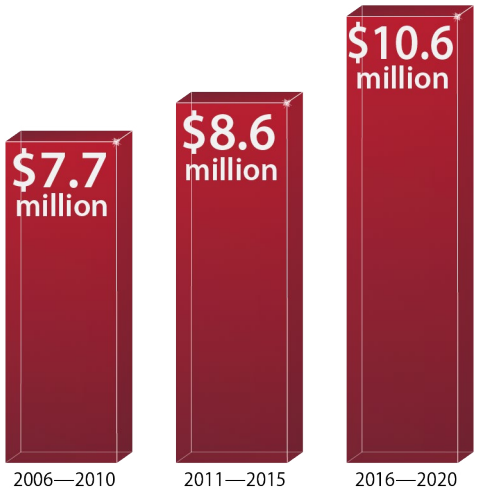
Core Metrics

$2.58 million Revenue
$1.93 million Sponsored research

Sponsored Research Agreements



Total Revenue



$2.6 million *UNeMed's $2.6 million in revenue in 2020 is the second most in company history, and a 22 percent increase over the 5-year rolling average.*

U.S. Patents

List of all U.S. patents issued to UNMC & UNO personnel during the fiscal year ending in 2020. Information includes patent numbers, patent titles, the date the patent was issued and the names of all co-inventors listed on the patent.

"Medical Inflation, Attachment, and Delivery Devices and Related Methods"
U.S. Patent No. 10,335,024 — issued July 2, 2019
- Shane Farritor
- Mark Rentschler

"Creatine Oral Supplementation Using Creatine Hydrochloride Salt"
U.S. Patent No. 10,342,771 — issued July 9, 2019
- Jonathan Vennerstrom
- Mark Faulkner
- Donald Miller

"Methods, Systems, and Devices Relating to Surgical End Effectors"
U.S. Patent No. 10,350,000 — issued July 16, 2019
- Shane Faritor
- Tom Frederick
- Joe Bartels

"Method and Apparatus for Fibrin Sheath Disruption"
U.S. Patent No. 10,357,601 — issued July 23, 2019
- Marius Florescu
- Maurino Flora
- David Black
- Celso Bagaoisan
- Suresh Subraya Pai

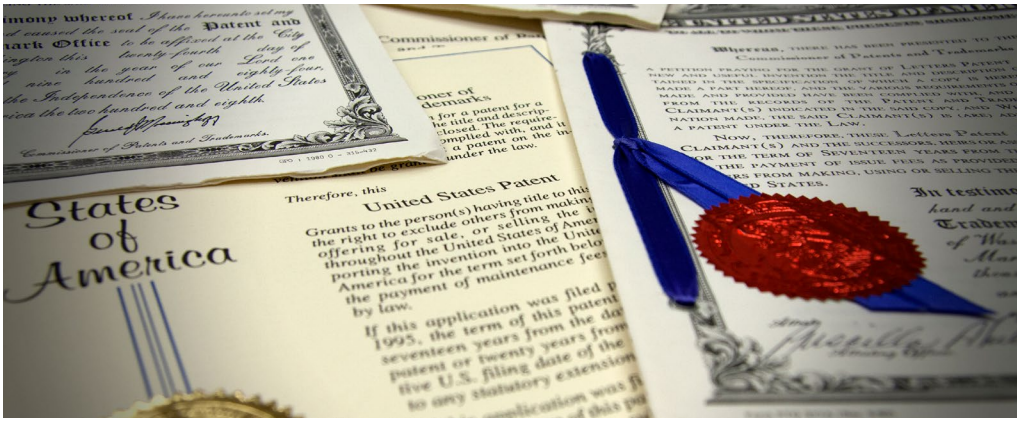
"Analogs of C5A and Methods of Using Same"
U.S. Patent No. 10,363,282 — issued July 30, 2019
- Sam Sanderson
- Tammy Kielian
- Mark Hanke
- Edward Morgan
- Marilyn Thoman
- Tamsin Sheen
- Kelly Doran
- Joy Phillips
- Elizabeth Virts

"Robotic Device with Compact Joint Design and Related Systems and Methods"
U.S. Patent No. 10,376,322 — issued August 13, 2019
- Tom Frederick
- Shane Farritor
- Eric Markvicka
- Dmitry Oleynikov

"Multifunctional Operational Component for Robotic Devices"
U.S. Patent No. 10,376,323 — issued August 13, 2019
- Jason Dumpert
- Dmitry Oleynikov
- Nathan Wood
- Amy Lehman
- Shane Farritor
- Mark Rentschler

"Medical Irrigation System"
U.S. Patent No. 10,398,811 — issued September 3, 2019
- Thang Nguyen
- Michael Wadman
- Vincent Morris
- Richard Morris

"Pyrrolomycins and Methods of Using the Same"
U.S. Patent No. 10,414,725 — issued September 17, 2019
- Kenneth Bayles
- Rongshi Li
- Yan Liu



"Platform Device and Method of Use to Assist in Anastomosis Formation"
U.S. Patent No. 10,433,847 — issued October 8, 2019
- Marius Florescu

"System and Method for Monitoring Pleural Fluid"
U.S. Patent No. 10,456,063 — issued October 20, 2019
- Kim Cluff
- Dimitrios Miserlis
- Abby Kelly
- Suzanne Stewart
- Max Twedt

"Local Control Robotic Surgical Devices and Related Methods"
U.S. Patent No. 10,470,828 — issued November 12, 2019
- Joe Bartels
- Tom Frederick
- Eric Markvicka
- Shane Farritor
- Jack Mondry

"Mixed Lineage Kinase Inhibitors for Hiv/Aids Therapies"
U.S. Patent No. 10,485,800 — issued November 26, 2019
- Howard Gendelman
- Harris Gelbard
- Stephen Dewhurst

"Polyethylene Glycol-Conjugated Glucocorticoid Prodrugs and Compositions and Methods Thereof"
U.S. Patent No. 10,485,809 — issued November 26, 2019
- Dong Wang
- Zhenshan Jia
- Xiaobei Wang
- Fang Yuan

"Sheath"
U.S. Patent No. 10,507,305 — issued December 17, 2019
- Gregory Gordon

"Creatine Ester Pronutrient Compounds and Formulations"
U.S. Patent No. 10,531,680 — issued January 14, 2020
- Jonathan Vennerstrom
- Donald Miller

"Multifunctional Assessment System for Assessing Muscle Strength, Mobility and Frailty"
U.S. Patent No. 10,568,547 — issued February 25, 2020
- Jason Johanning

"Circulating Antibodies Against MAA Adducts as Biomarker for Coronary Artery Disease"
U.S. Patent No. 10,591,468 — issued March 17, 2020
- Daniel Anderson
- Michael Duryee
- Geoffrey Thiele

"Methods, Systems, and Devices Related to Robotic Surgical Devices, End Effectors and Controllers"
U.S. Patent No. 10,603,121 — issued March 31, 2020
- Shane Farritor
- Tom Frederick
- Joe Bartels
- Eric Markvicka
- Jack Mondry

"Method for Subtyping Lymphoma Types by Means of Expression Profiling"
U.S. Patent No. 10,607,717 — issued March 31, 2020
- Kai Fu
- Timothy Greiner
- Wing Chan
- Dennis Weisenburger

"Robotic Surgical Devices, Systems, and Related Methods"
U.S. Patent No. 10,624,704 — issued April 21, 2020
- Shane Farritor
- Jason Dumpert
- Yutaka Tsutano
- Nishant Kumar
- Philip Chu
- Erik Mumm

"Methods, Systems and Devices for Surgical Access and Procedures"
U.S. Patent No. 10,695,137 — issued June 30, 2020
- Shane Farritor
- Amy Lehman
- Mark Rentschler
- Jeff Andrew Hawks
- Stephen Platt

"Methods for Identifying, Diagnosing, and Predicting Survival of Lymphomas"
U.S. Patent No. 10,697,975 — issued June 30, 2020
- James Armitage
- Wing Chan
- Kai Fu
- Timothy Greiner
- Julie Vose
- Dennis Weisenburger

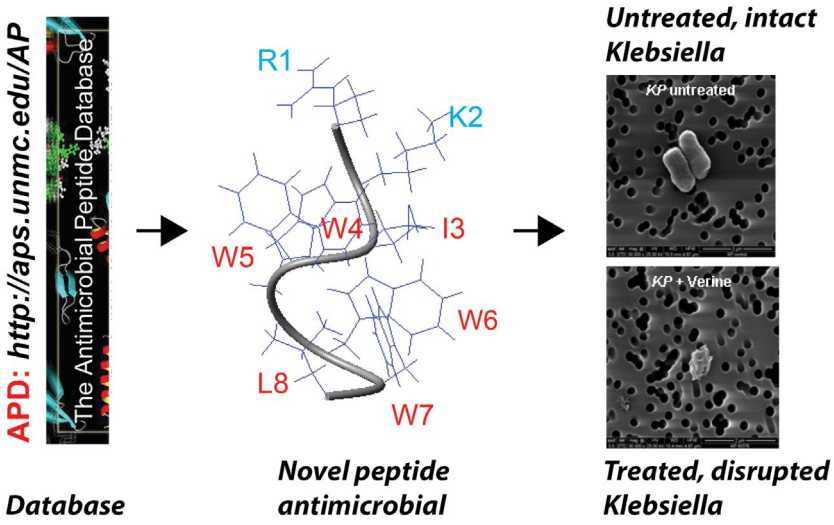
Featured Technologies

ANTIMICROBIAL PEPTIDES

Give orthopedic implants 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 peptides 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. Of these patients, approximately 100,000 will undergo a repeat procedure to alleviate pain associated with prosthetic loosening or bacterial infection.

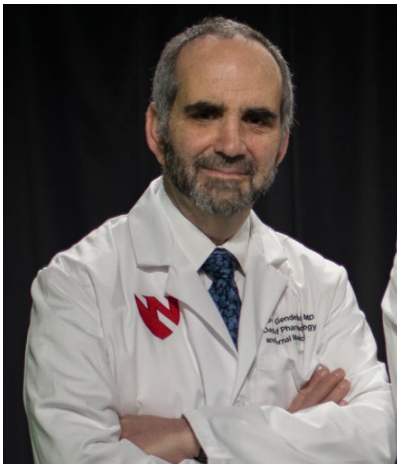
As an opportunistic pathogen, MRSA has evolved numerous strategies for evading the human immune system. MRSA has a particularly notorious ability to find, attach to, and create bacterial biofilms on orthopedic implants. Once a MRSA biofilm is fully formed, the only effective treatment involves total 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*

ANTIRETROVIRAL THERAPY

New delivery method opens powerful option for HIV



LASER ART inventor Howard Gendelman, MD.

UNMC researchers have developed long-acting forms of a number of antiretroviral compounds than can be given anywhere from once every couple of months to once a year, eliminating the need for current treatment strategies that require daily administration of medicine.

Antiretroviral therapies, or ART, are 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.

Featured Technologies

EASI-CRISPR

Get more out of CRISPR with new insertion protocol

Easi-CRISPR inventor Channabasavaiah Gurumurthy, PhD.

Rundown

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

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 unwieldly, imprecise and very inefficient. In short, CRISPR has 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.

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.

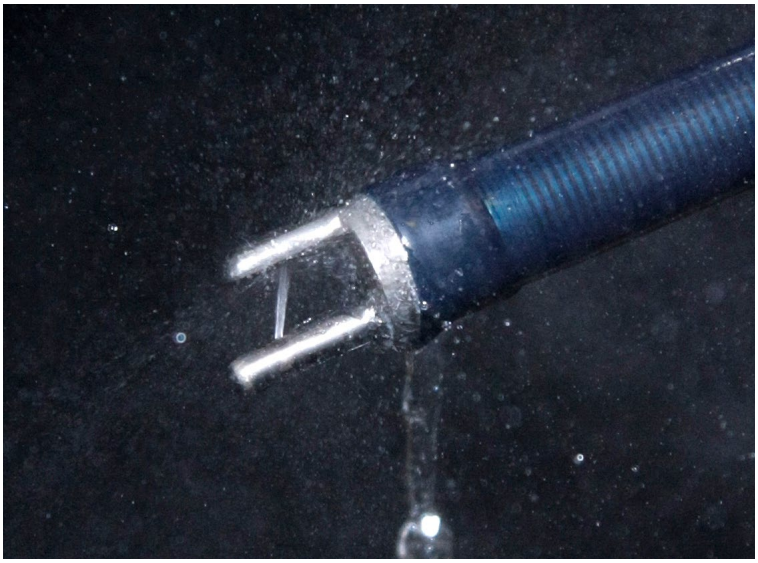
Rundown

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

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.



Featured Technologies

NF-KB PATHWAY INHIBITOR

UNMC scientists invent new compounds to treat cancer

UNMC researcher Amarnath Natarajan, PhD.

Researchers at the University of Nebraska Medical Center created a molecule capable of specifically inhibiting the NF-kB pathway, a key target involved in a variety of cancers and other diseases.

The NF-kB pathway is often overactive in a number of cancers. Therefore, new ways to shut off this pathway could yield important new cancer treatments.

Amarnath Natarajan, PhD, and his team developed a small molecule called 36-252 that destroys key members of the NF-kB pathway—specifically the proteins IKKb and IKKa. In ovarian cancer cell studies, 36-252 effectively inhibited cell growth at nanomolar concentrations, stimulated cell death (apoptosis), and effectively inhibited NF-kB activity. 36-252 was also effective at destroying ovarian cancer stem-like cells.

UNeMed is interested in forming collaborations with industry to further explore the potential of 36-252 as a novel therapy of the treatment of cancer and other diseases associated with overactive NF-kB.

Rundown

- *Inhibits the NF-kB pathway*
- *Causes degradation of IKKa and IKKb*
- *Nanomolar potency in cell-based studies*

AEROSOL CAPTURE MASK

New device protects healthcare workers from viruses

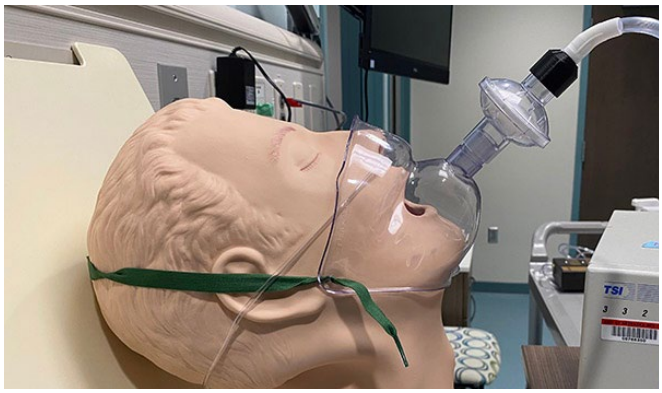
A new protective device can help protect healthcare workers everywhere, preventing infected patients from spraying or exhaling viral agents and potentially infecting others in the room.

Developed by the chair of UNMC's Department of Anesthesiology, Steven Lisco, MD, the Infectious Aerosol Capture Mask is a face tent that covers the patient's mouth and nose, and is then coupled with a viral filter and a special adapter that connects the unit to standard vacuum supplies in most clinical settings.

The Nebraska Medicine Innovation Committee has approved the device for use in its facilities, and has already deployed them in operating rooms and elsewhere in the hospital.

Hospitals risk wider contamination from COVID-19 patients when they cough or even just breathe. They produce microscopic particles that float through the air of their rooms, and potentially beyond. Even patients that have no symptoms may still unwittingly spread the virus in the same way, particularly when wearing supplemental oxygen or undergoing the procedures that insert or remove breathing tubes.

Dr. Lisco said in a recent announcement the device performed well in early tests, "catching more than 90 percent of airborne particles expelled in the mask, ultimately preventing the aerosol from entering the patient environment." He added: "Even when the vacuum wasn't turned on, the mask was still 85 percent effective as a barrier."



At this initial stage, the special adapter for the Infectious Aerosol Capture Mask is available for purchase through Omaha Custom Manufacturing at info@omahacustommfg.com or 800-228-5021. All other components are commonly accessible in most clinical settings and readily found through various medical equipment suppliers.

A future version of the technology will incorporate all components into one contiguous device, but that will not be available for purchase until later this year.

Rundown

- *Limits caregiver exposure to aerosolized viral agents*
- *Covers the patient's mouth and nose*
- *Assembled from commonly available products in clinical settings*
- *Universal adapter connects to standard vacuum line found in most clinical settings*

Featured Technologies

CUSTOM MEDICAL SIMULATORS

Lifelike models provide doctors just-in-time training

Nick Markin, MD, Director of Perioperative Imaging at the University of Nebraska Medical Center, invented custom medical procedure simulators. These anatomically accurate simulators are made with artificial mimics of bone, tissue and vasculature. They are echogenic and provide training for multiple critical vascular access and non-vascular access procedures when they are needed most.

Anesthesiologists perform many routine procedures, but occasionally receive patients with extreme trauma that require immediate and unique assistance. Due to the rarity of these events, it is difficult for clinicians to receive this crucial training. To solve this training gap, Dr. Markin developed a process for creating custom medical procedure simulators that fit into the "just-in-time" educational model. A "just-in-time" training platform is one that provides educational tools and courses as they are needed, rather than waiting for online courses or sporadic seminars.

Dr. Markin's portfolio currently contains intraosseous infusion and arterial cannulation models, with several more simulators in development.

Rundown

- *Anatomically accurate*
- *Layered models: artificial bone, tissue and vasculature*
- *Echogenic*
- *Critical vascular and non-vascular access procedures*

GUIDED ENDODONTIC SYSTEM

Perform easy, precise endodontics...every time

Guided dental implant surgery has become routine, but there are no commercial products for guided endodontics.

Greg Bennett, DMD, has developed a novel, complete system for endodontics.

The system includes drills, hollow channel posts, and guided sleeves. With this system, any dentist can easily and precisely initiate the endodontic access for treatment, create post space for the corresponding endodontic post, and remove the post via in situ obliteration.

Every dental office uses guided implant surgery. Soon, every dental office will use guided endodontics too.

Rundown

- *System includes drills, hollow channel posts, and guided sleeves*
- *Improved precision during both implantation and removal*
- *Optimized for guided endodontic access, post-space preparation, and post removal*
- *Designed to match the cutting end diameter of commonly used endodontic files*

Featured Technologies

GEMS FOR COVID-19

Find answers with genetically engineered mice for SARS-CoV-2

Mouse models could create answers to several lingering unanswered questions about the COVID-19 outbreak and the virus that created it, SARS-CoV-2. Geneneticlly engineered mice will help scientists understand the molecular mechanisms of the virus, repurpose currently available antiviral drugs, and provide an opportunity to develop new therapies and vaccines against COVID-19. One major challenge in achieving these goals is the lack of suitable preclinical animal models.

Unfortunately, SARS-CoV-2 only infects mice if they express human ACE2. This feature, combined with a wealth of genetic tools available only in mice, offers a unique opportunity for creating a versatile set of genetically engineered mouse models useful for COVID-19 and SARS-CoV-2 research.

Rundown

- *Preclinical mouse models directed towards a variety of members in the SARS-CoV-2 transmission process*
- *Models are generated under different mouse backgrounds*
- *Research use only*

UNMC researcher, Channabasaviah Gurumurthy, PhD, has developed three broad categories of genetically engineered mouse models, and about 30 different model designs for SARS-CoV-2 research:

1. Knocking-in expression cassettes, or point mutations, into the endogenous mouse ACE2 locus.

2. Knocking-in CRE-activatable- or tetracycline inducible-hACE2 expression cassettes into safe-harbor loci, by re-engineering the existing reporter or inducer lines.

3. Knocking-in CRE-activatable cassettes into the mouse ACE2 locus.

The natural non-permissiveness of mice to SARS-CoV-2 infection in combination with a wide variety of available genetic tools and molecular switches offers a unique opportunity to make this species useful for COVID-19 research.

SYNTHETIC BYPASS GRAFT

Innovative graft material flexes, improves blood flow for patients with peripheral artery disease

Researchers at UNMC developed a highly flexible vascular bypass graft for the treatment of peripheral artery disease.

Peripheral artery disease is a common circulatory condition for the elderly, with more than 3 million new cases per year. As the body ages, the vessels carrying vital oxygen and nutrients throughout the bloodstream begin to weaken and narrow, reducing blood flow to the limbs.

To reinforce the vessels, and support improved blood flow, physicians can surgically implant grafts that protect the vessel integrity. However, traditional grafts tend to be rigid and risk severe bending and kinking during normal limb use. Grafts placed over major joints like knees and elbows have particularly high fail rates.

A team of researchers at UNMC, led by vascular surgeon Jason MacTaggart, MD, developed a synthetic graft material that is more flexible and prevents severe bending and kinking during normal limb use. Their tests indicate that such a graft may improve blood flow patterns and reduce vascular torsion in patients with peripheral artery disease.

Rundown

- *Reinforces vessels, supports improved blood flow*
- *More flexible, prevents severe bending and kinking*
- *Ideal for use in major joints like knees, elbows*

This new graft design may improve options for patients suffering from peripheral artery disease and offer a higher quality of life.

Featured Technologies

SAMPLE COLLECTION DEVICE

New nasopharyngeal specimen collection kit simplifies, improves virus testing accuracy

Clinicians at the University of Nebraska Medical Center have developed a self-contained specimen container that collects and preserves nasopharyngeal specimens for testing.

The user inserts the collection device into the patient's nose and depresses the plunger. The pressure releases saline from one of two reservoirs, irrigating the nasal canal.

The saline then drains into the second reservoir—the specimen chamber—and mixes with a pre-agent to preserve the sample. The user then caps the device to seal all the ports and to prevent leakage.

The entire device is then transported to the laboratory for appropriate testing.

The collection device could be mailed directly to patients so they can take the test in the privacy of their homes. The patient would then mail the sample chamber directly to the laboratory.

Traditionally, a nurse squirts saline into a patient's nose and then inserts a nasal swab for specimen collection, which could lead to false negative test results. The collection device prevents the type of false negatives that occur due to improper washing of the nasal passages.

This new sample collection device could be used in the clinic to test for a variety of viruses like SARS-CoV-2 and the more common influenza viruses.

Rundown

- *Alternative to traditional nasopharangeal swabs*
- *One-stop solution for gathering, storing and testing nasal secretions*
- *Prototype available for review*

INFLAMMATORY BOWEL DISEASE BIOMARKER

New tool can diagnose ulcerative colitis, Crohn's disease

Investigators at the University of Nebraska Medical Center have found that a naturally occurring indicator of inflammation can also work as a non-invasive diagnostic for patients with inflammatory bowel disease.

Rundown

- *Non-invasive serum test for IBD*
- *Diagnostic differentiator between UC and CD*
- *ELISA-based assay*

Inflammatory bowel disease is a term that refers to two chronic conditions, ulcerative colitis and Crohn's disease. The causes of inflammatory bowel diseases are uncertain and proper diagnosis requires a multitude of often invasive diagnostic procedures. Diagnostic measures are also expensive, uncomfortable and sometimes life threatening. The similarity of the conditions and the potential crossover of symptoms makes a clear diagnosis between ulcerative colitis and Crohn's disease difficult, especially during initial diagnoses.

But UNMC researchers found a way to tell the difference.

Malondialdehyde is a natural but potentially dangerous chemical compound. It's presence indicates cell damage caused by inflammation in a process called lipid peroxidation. In some conditions, malondialdehyde can bond with another naturally occurring compound, acetaldehyde. The combination forms the unique malonilaldehyde-acetaldyehyde adduct, or MAA for short. MAA is unstable and provokes an immune response that attacks the patient's own cells.

UNMC researchers found that antibody responses to MAA precisely differentiates between ulcerative colitis and Crohn's disease.

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