# Mason and Military Health

*Driving Innovation*

George Mason University | Institute for Biohealth Innovation


## Come Innovate With Us.

George Mason University, located in Northern Virginia, is proud to support the American warfighter through timely research with tangible impacts. Hundreds of Mason faculty and thousands of Mason students form diverse teams with the expertise necessary to address many of the complex problems facing the military. We are committed to the effective translation of our research findings to enhance health and the quality of life for service members, veterans, and their families. We value partnerships and we strive to continue growing and innovating with the help of our collaborators.

*Mason is open for business.*

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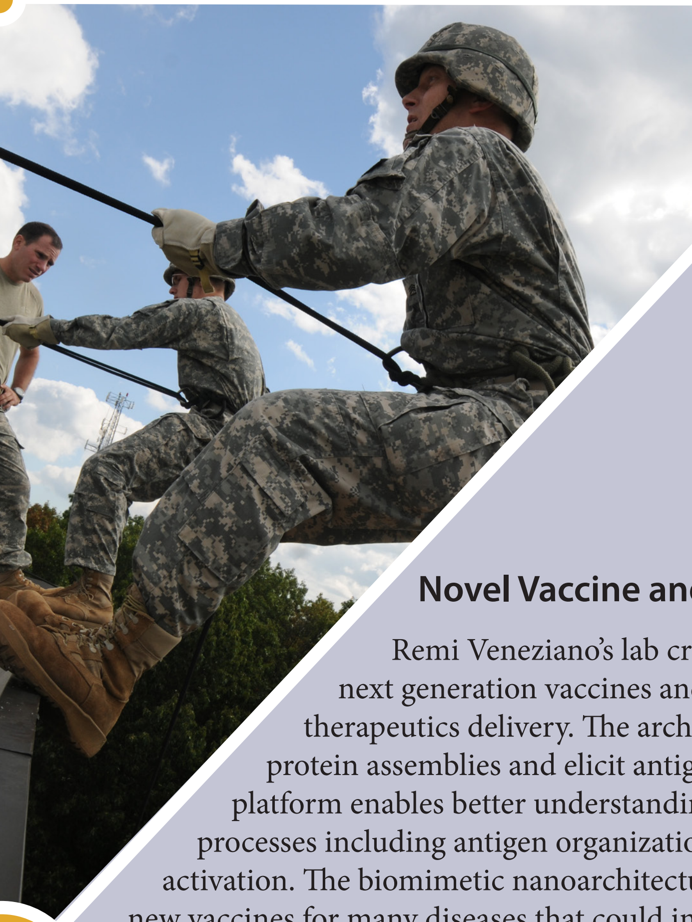
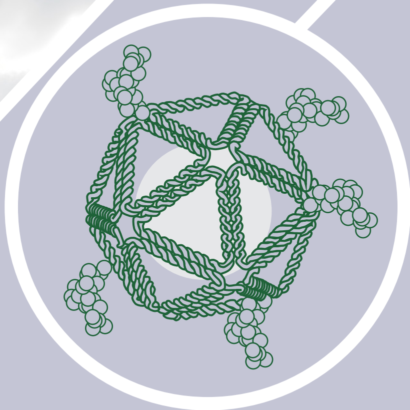
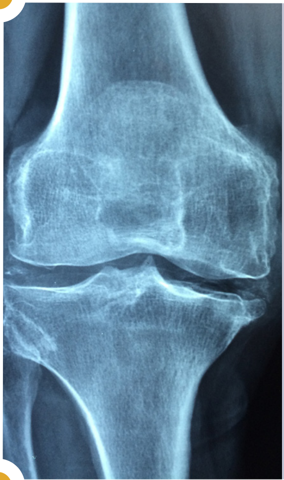
# Readiness





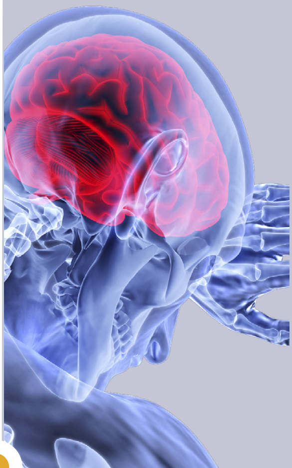
## Novel Vaccine and Drug Delivery Platform

Remi Veneziano's lab creates DNA origami for use in next generation vaccines and as bio-vehicles for targeted therapeutics delivery. The architectures mimic specific viral protein assemblies and elicit antigen recognition by B-cells. This platform enables better understanding of natural immunological processes including antigen organization and valency on B-cell activation. The biomimetic nanoarchitectures are being studied to develop new vaccines for many diseases that could impair the effectiveness of military personnel at home and deployed abroad, keeping our warfighters healthy.



## Non-invasive, Real-time Knee Injury Monitor

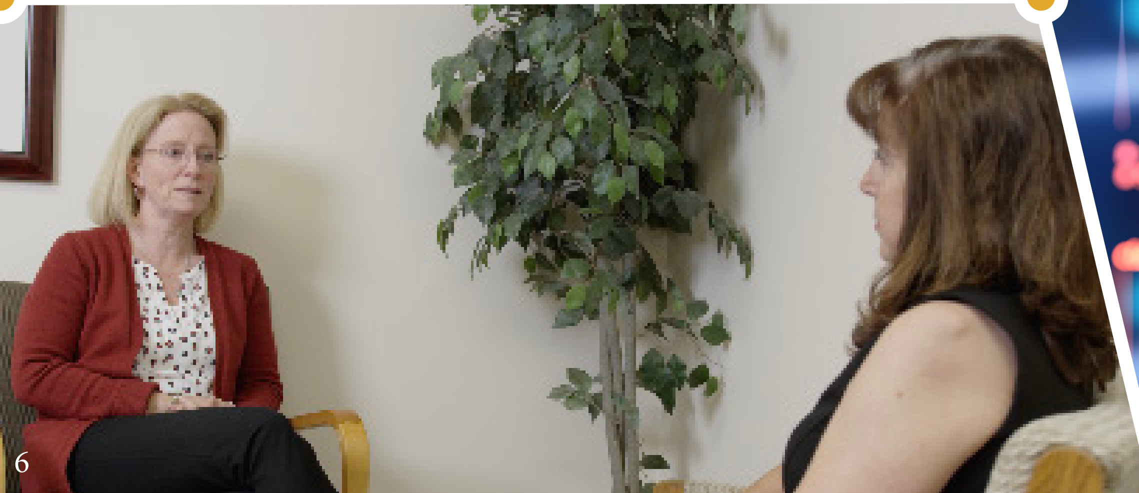
A knee sleeve developed by Lance Liotta and team provides real-time physiological and clinical measurements to improve operational readiness. The device can shorten the rehabilitation for acute knee injuries, including strains, sprains, dislocations, and ligament tears. The soft, form-fitting, rugged sleeve has integrated sensors and associated microelectronics to effectively monitor range of motion, inflammation, pressure, swelling, acceleration and more. In real-time, the device collects and wirelessly transmits data to user interfaces like smartphones, tablets, or computers.



## Rapid Saliva Assay for Traumatic Brain Injury

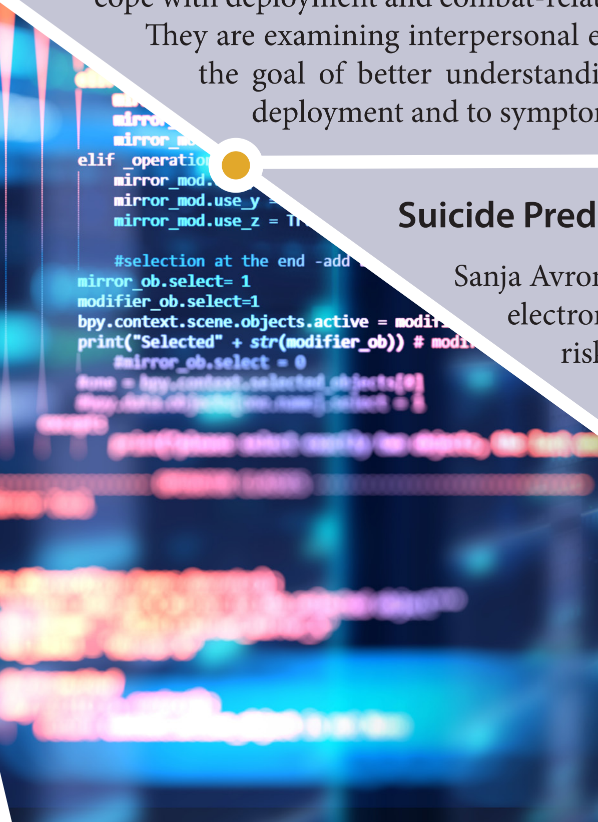
Chip Petricoin and Shane Caswell, with Karolinska Institute collaborators, identified promising salivary biomarkers for detecting mild traumatic brain injury (TBI) and concussion in young athletes, a predicate cohort for military populations. Autoantibody profiling, ultra-low abundance biomarker capture, and high resolution mass spectrometry identified proteins that are differentially expressed post-TBI compared to matched controls as well as overall high impact incidence. The development of a biomarker-based diagnostic test could provide evidence for making return-to-duty decisions.

# Mental Health and Resilience



## Military Family Relationship Health

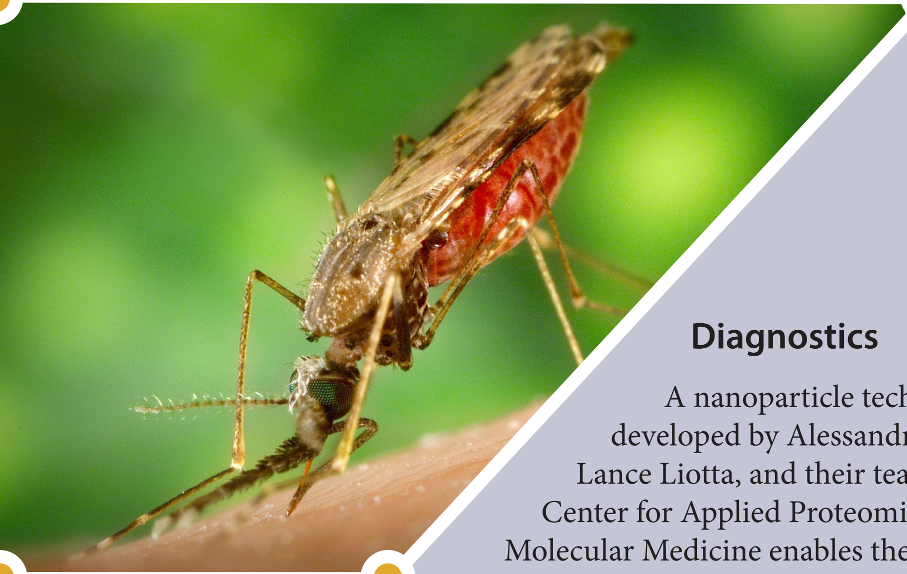
Keith Renshaw's team is working to provide support for military personnel and their families by conducting research on how service members, veterans, and their families cope with deployment and combat-related posttraumatic stress disorder (PTSD). They are examining interpersonal effects of trauma, stress, and anxiety with the goal of better understanding individual and couples' reactions to deployment and to symptoms of combat-related PTSD.




## Suicide Prediction

Sanja Avromovic is mining Veterans Affairs electronic health records to investigate suicide risk in veterans. Her team has developed models that leverage rare social determinants of illness codes to make predictions that can assist healthcare providers with early interventions.

# Infectious Disease



## Diagnostics

A nanoparticle technology developed by Alessandra Luchini, Lance Liotta, and their team in the Center for Applied Proteomics and Molecular Medicine enables the early detection of viral infections. In one step, the hydrogel particles trap, concentrate, and protect low-abundance, potential disease biomarkers that are sparsely dispersed in blood, urine or saliva samples. The technology is being used to detect cancer, bacteria, and viruses and has the potential to be developed into rapid, multi-disease diagnostics. Mason researchers have used the technology to look at infectious diseases ranging from Tuberculosis to Lyme disease, Rift Valley Fever Virus, and Zika.

## Disease Surveillance

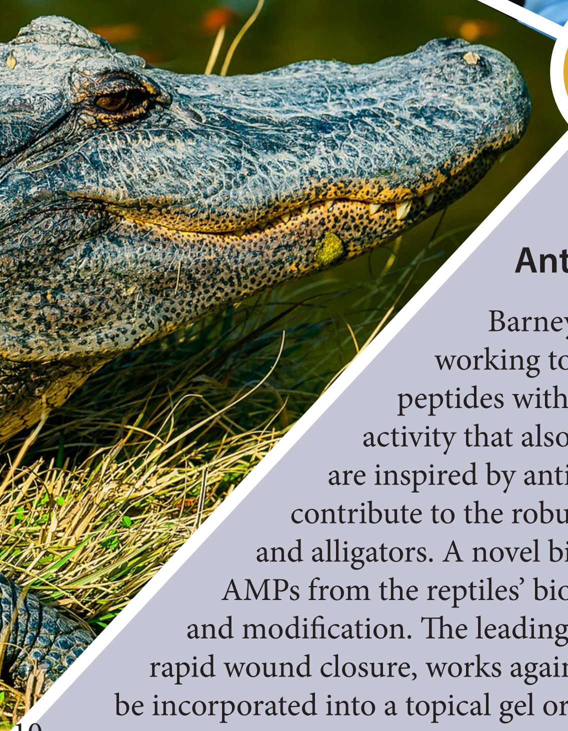
Michael von Fricken and his lab conduct vector-borne disease surveillance, control, and pathogen discovery with ongoing projects in Kenya, Mongolia, and Haiti. They are focusing on emerging pathogens transmitted by mosquitoes and ticks.

## New Therapeutics

Mason researchers in Kylene Kehn-Hall's lab are identifying critical host factors that are necessary for viral replication and pathogenesis, and evaluating small molecule inhibitors that target essential host-based events for their therapeutic. The Kehn-Hall team is also partnering with Barney Bishop to analyze innate immunity in alligators and other reptiles to identify host defense peptides with antiviral properties and potential therapeutic applications.

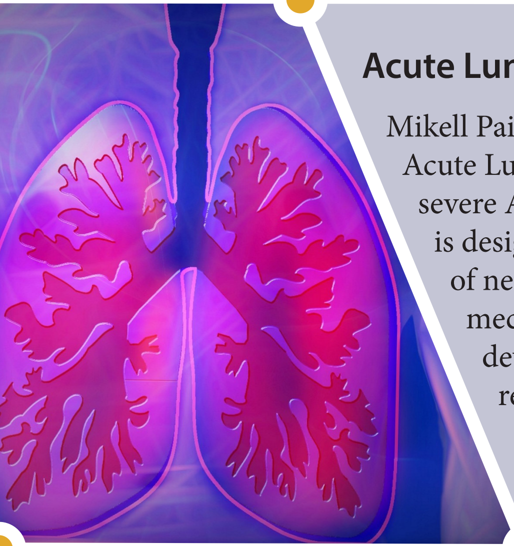
## Rapid Disease Detection

Robin Couch's team is using volatile organic compounds (VOCs) as diagnostic fingerprints for the rapid detection of several pathogens, including *Brucella neotomae*, *Yersinia pestis, Burkholderia cenocepacia*, and *Francisella tularensis*. The VOC fingerprints can distinguish wildtype from engineered, kanamycin-resistant strains of select biothreat agents and differentiate healthy mice from those infected with *Y. pestis* or *F. tularensis*, in as little as 30 minutes.



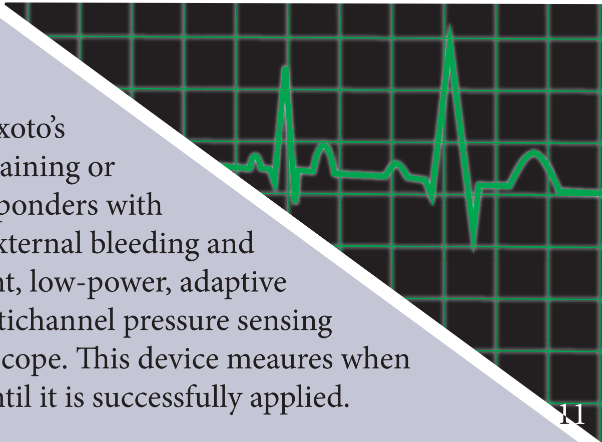
## Antimicrobial Peptides

Barney Bishop and Monique van Hoek's labs are working together to discover and test novel synthetic peptides with potent antimicrobial and anti-biofilm activity that also help wounds heal. The new compounds are inspired by antimicrobial peptides (AMPs) that contribute to the robust innate immunity of Komodo dragons and alligators. A novel bioprospecting-based approach sequesters AMPs from the reptiles' biological samples for down-stream analysis and modification. The leading candidate uncovered thus far promotes rapid wound closure, works against a broad spectrum of bacteria, and can be incorporated into a topical gel or dressing for combat wounds and burns.



## Acute Lung Injury Therapeutic

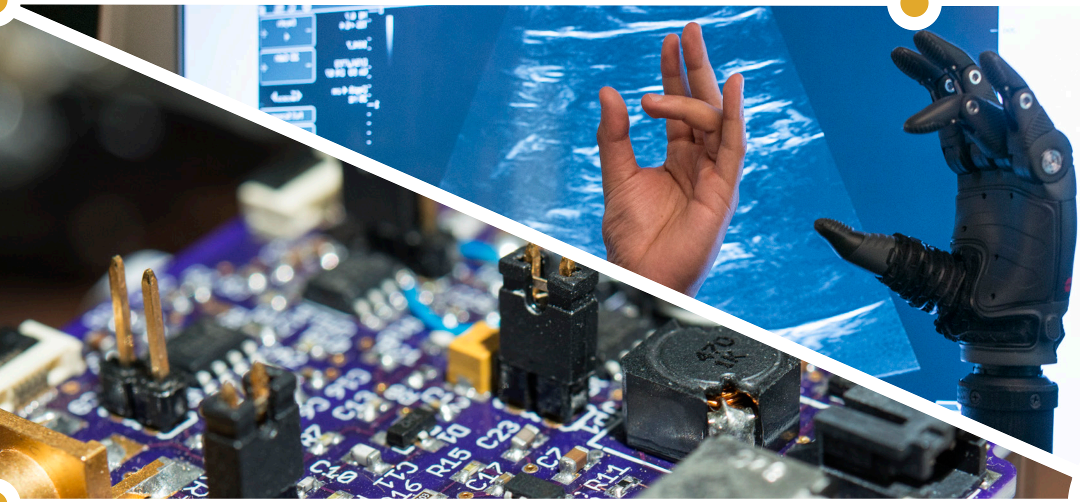
Mikell Paige's research targets novel treatments for Acute Lung Injury (ALI) to prevent progression to severe Acute Respiratory Distress Syndrome. The lab is designing pharmaceuticals for warfighters at risk of needing prolonged critical care support, such as mechanical ventilation. The drug currently under development is an immunomodulatory agent that reduces neutrophil and leukocyte infiltration in the peri-bronchial areas in murine models for ALI, but does not induce immunosuppression or susceptibility to pulmonary infection.



## Smart Tourniquet

A new device developed by Nathalia Peixoto's lab can deliver real-time feedback in a training or battlefield environment to assist first responders with properly securing a tourniquet to stop external bleeding and provide rapid treatment. The light-weight, low-power, adaptive embedded system is comprised of a multichannel pressure sensing polymers, microcontroller, and a stethoscope. This device meaures when arterial pulse disappears and the time until it is successfully applied.

# Rehabilitative Medicine



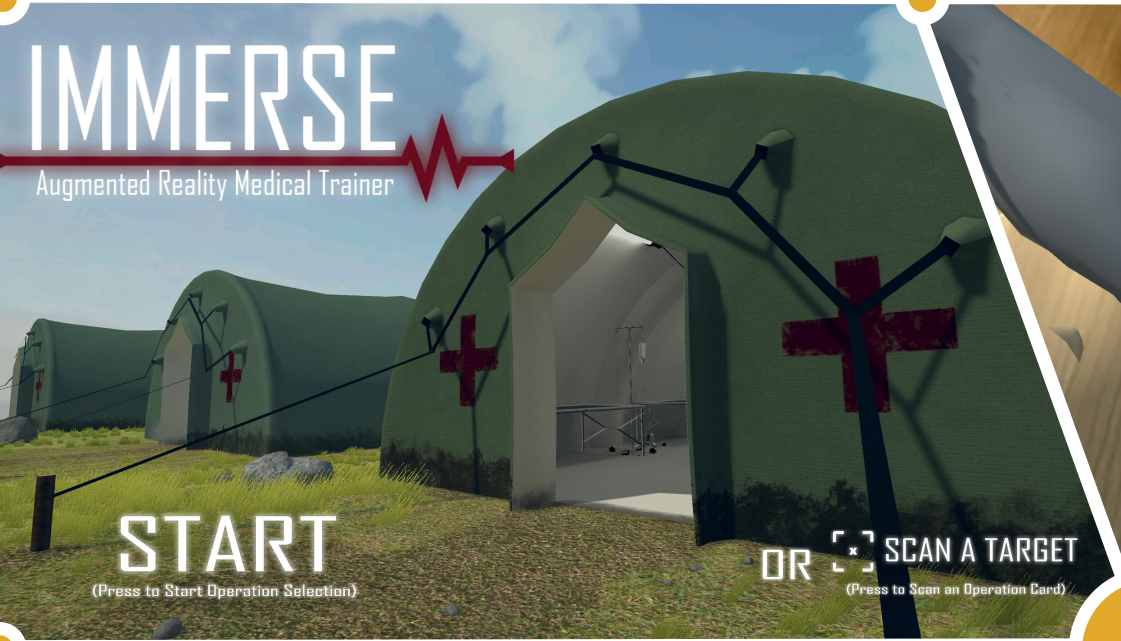

## Ultrasound-guided Prosthetic Technology

Siddhartha Sikdar's lab developed a novel prosthetic control system to enable more robust, intuitive, and dexterous control of prosthetics. Miniaturized ultrasound imaging transducers and image analysis algorithms decode the movement intent of individual digits, different intended grasps, and wrist movements, based on deformation of muscles in the residual limb. This technology helps patients regain mobility and independence by reducing training time and enabling improved functionality and usability of advanced prosthetic devices.

## Incomplete Spinal Cord Injury Rehabilitation

Andrew Guccione and team integrated training methods to help patients with incomplete spinal cord injuries restore walking abilities years after injury. The team developed complex movement drills as an intervention to improve muscle oxygen utilization and motor control, thereby reducing fatigability and improving mobility.

# Medical Simulation



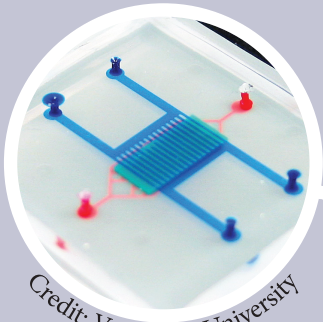

In partnership with Chi Systems, the Virginia Serious Games Institute developed IMMERSE, an Augmented Reality (AR) learning solution for medic training that was prototyped for the U.S. Army. The goal of this product is to provide a hands-free AR solution that presents the user with guided medical procedures for classroom training.


It is also capable of being deployed in the field for real-time guided support. The tool was designed to provide instructions and testing for a variety of medical procedures, including cricothyroidotomy, hemorrhage control, and tension pneumothorax. Additionally, the guide can be customized for other medical training needs.

# Research Facilities & Platforms

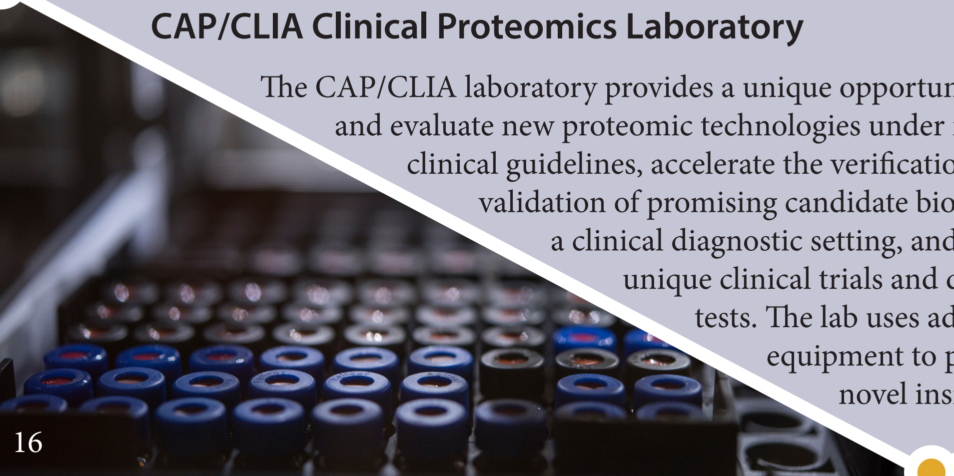
## Organoid Platform: Human Disease Model

The Narayanan team is using organoid platforms to study diseases in human context. The human blood brain barrier model established at Vanderbilt University is a new tool in the human disease modeling toolbox to understand, predict, and treat blood brain barrier inflammation caused by infectious agent exposure. Mason scientists are using this powerful tool to discover novel host-derived biomarkers to predict inflammatory damage, evaluate new and FDA approved anti-inflammatory therapeutics, and elucidate the role of extracellular vesicles in infected host tissues.



Credit: Vanderbilt University

## CAP/CLIA Clinical Proteomics Laboratory



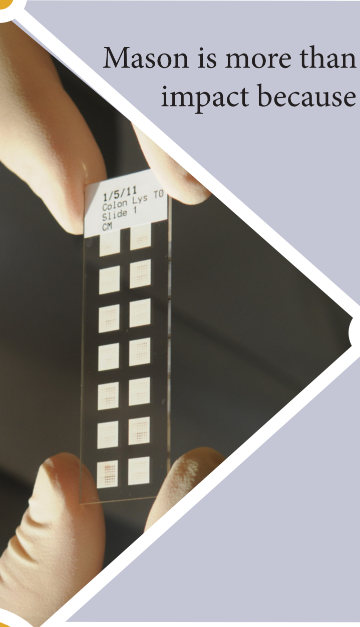
The CAP/CLIA laboratory provides a unique opportunity to assess and evaluate new proteomic technologies under rigorous clinical guidelines, accelerate the verification and validation of promising candidate biomarkers in a clinical diagnostic setting, and implement unique clinical trials and diagnostic tests. The lab uses advanced equipment to produce novel insights.

## Biomedical Research Lab (BRL)
## Open for Collaboration

The BRL is one of 13 regional biocontainment labs funded by NIAID/NIH. The 52,000 square-foot, high-security facility is located adjacent to Mason's Science and Technology Campus in Manassas, Virginia. It is capable of housing multiple species and has a variety of established animal models with an emphasis on aerosolized exposures.

# An Emphasis on Action

Mason is more than just a force for innovation. Our ideas have real-world impact because we put them into motion – they don't stay ideas for long.




Our faculty hold **101** patents

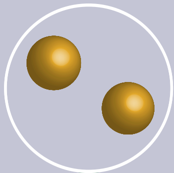
with **8** associated start-ups

CERES NANO

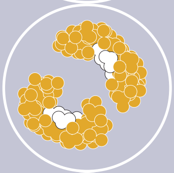
Powering the future of Diagnostics

A sampling of George Mason University's biohealth intellectual property:

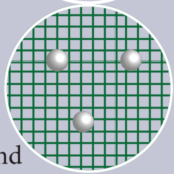
Artificial Body Part Control System using Ultrasonic Imaging



Biocompatible Lipid Polymeric Patchy Particles



Binding Domain Mapping



Collapsible Collection Vessel with Tethered Affinity Net

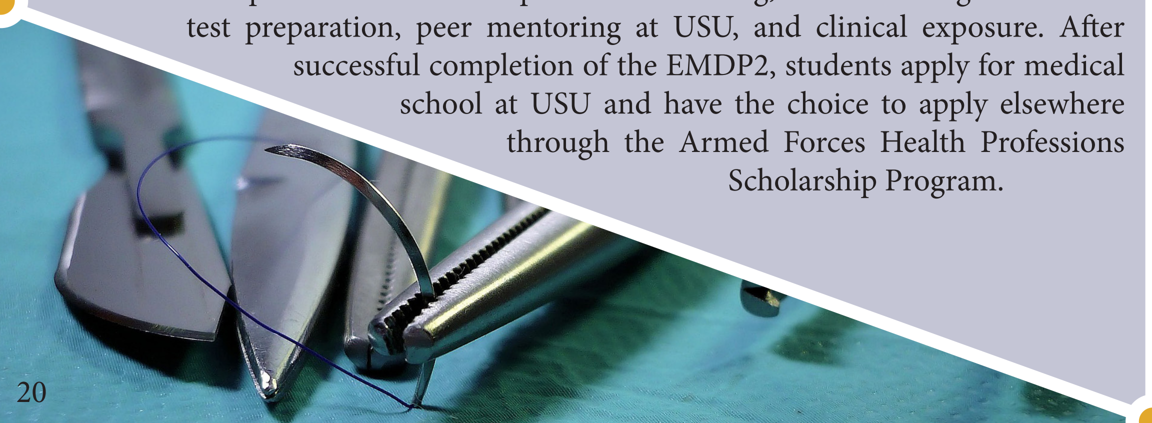
Antimicrobial Peptides with Wound Healing Activity- DRGN 1

The core of Ceres Nanosciences is the Nanotrap® particle technology. The Nanotrap® technology captures, concentrates, and preserves low abundance analytes from samples, improving diagnostic testing. The technology was invented at George Mason University and the company remains located in Prince William County, Virginia. The technology has been developed with funding from the National Institutes of Health (NIH), the Defense Advanced Research Projects Agency (DARPA), the Bill and Melinda Gates Foundation, the Defense Threat Reduction Agency (DTRA), and the Commonwealth of Virginia.

# Enlisted to Medical Degree

## Educating Future Military Doctors

George Mason University partners with Uniformed Services University of Health Sciences (USU), U.S. Army, Navy, Air Force, and Marine Corps to offer a 24-month pre-med program for active duty enlisted service members. The program, called Enlisted to Medical Degree Preparatory Program (EMDP2), allows the service members to complete prerequisites and participate in training that positions them as competitive applicants to medical school. The service members enroll in a curriculum offered at Mason's SciTech Campus and also receive pre-health advising, medical college admission test preparation, peer mentoring at USU, and clinical exposure. After successful completion of the EMDP2, students apply for medical school at USU and have the choice to apply elsewhere through the Armed Forces Health Professions Scholarship Program.



Joshua Richter was Army Sgt. 1st Class when he was accepted into the first cohort of EMDP2 in 2014.

# Partnerships

George Mason University is open for business and values collaborations that advance our research.

## Collaborations

Department of the Navy · United States of America

Office of Naval Research · ONR · Science & Technology

WRAIR · Walter Reed Army Institute of Research · Soldier Health • World Health

hjf

USU · Uniformed Services University

## Funding

SAMHSA · Substance Abuse and Mental Health Services Administration

Defense Threat Reduction Agency · United States of America

DARPA

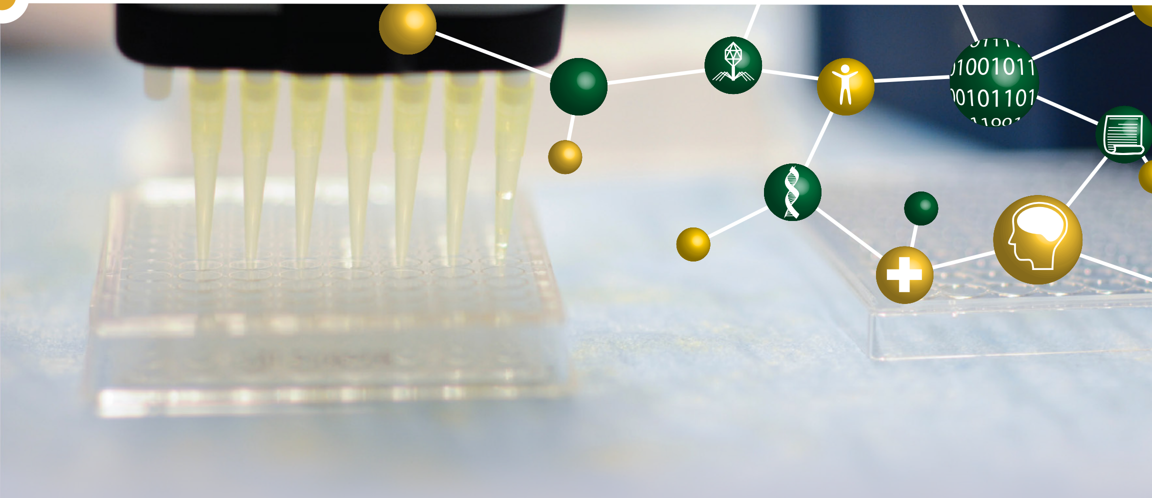
Department of Defense · United States of America

NIH

NSF

HRSA · Health Resources & Services Administration

# About the IBI



Mason's Institute for Biohealth Innovation (IBI) promotes and supports advances in human health and wellbeing at multiple scales, from individuals to populations. Through IBI, 200+ Mason faculty and thousands of students come together across disciplines to develop innovative new technologies, approaches, and interventions to predict, prevent, treat, and eradicate disease, improve care, and enhance the human condition.

Our world-class research community works hand-in-hand with individuals and organizations to develop and implement solutions to today's most pressing health issues.

# Come Innovate With Us

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