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FEATURED

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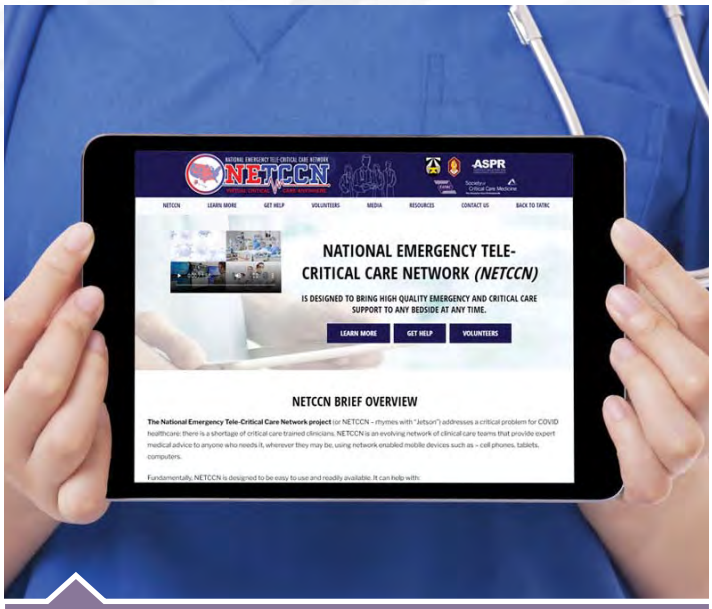
TiDE and NETCCN Expand to Deliver More Comprehensive Tele-Critical Care Services

The pieces of the National Emergency Tele-Critical Care Network (NETCCN) and Technology in Disaster Environments (TiDE) ecosystem are coming together to expand our ability to deliver more and more comprehensive tele-critical care services to more places during the COVID-19 pandemic, future disasters and – eventually – in support of large scale combat operations (LSCO).

This quarter, with a combination of CARES Act (The Coronavirus Aid, Relief, and Economic Security Act) funding from both the Department of Defense (DoD) and the U.S. Department of Health and Human Services (HHS), TATRC awarded several key components of this strategy and ecosystem:

- **Phase 2 of NETCCN: Additional funding for TATRC's four clinical-technical teams to deliver tele-critical care to hospitals and other sites of care across the nation (as well as resources to incorporate "virtual hospital" capabilities and work across teams and platforms);**
- **Cross-Platform Application Platform (C-PAM): Funding to a coordinated group of NETCCN teams to share data across platforms using standards, creating an interoperable ecosystem for disaster medicine;**
- **Medical Device Interoperability and Autonomy (MDIA) projects: Awards to three project teams to accelerate interoperability, remote control, and automation of mechanical ventilators and infusion pumps for integration into the NETCCN platforms in support of tele-critical care of COVID-19 patients. This effort will create and add "virtual hospital" capabilities to NETCCN and provide hospital-like functionality to the platform; and**
- **Technology in Disaster Environments Learning Accelerator (TLA): Funding to accelerate the availability and application of insights from the use of tele-critical care through the National Emergency Tele-Critical Care Network (NETCCN) and other technologies in civilian and military disaster and mass casualty events.**



NETCCN provides remote, expert medical advice to anyone from the convenienve of a mobile app!

You can find further details for each of these new awards inside the individual Press Releases on the TATRC website at https://www.tatrc.org/www/resources/covid-19.html.

Please stay tuned for updates on the significant impact that these projects will have on our fight against the pandemic and how TATRC translates what we've built and learned from COVID-19 to positively affect Warfighter performance and combat casualty care!

For more information on this project, please contact Mr. Matthew Quinn, matthew.t.quinn3.civ@mail.mil.

Team TATRC Hits a Home Run with Three Distinguished VIPs

Baseball players weren't the only ones making big plays this Spring! TATRC had the distinct honor of hosting three distinguished VIPs over the course of just a few weeks' time! Check out the replays here!

Our eventful Spring started with a visit from the Commanding General of Army Futures Command, GEN John M. Murray, who spent three whole hours at TATRC for a tour and briefing on our current initiatives and future focus areas! Along with USAMRDC CG, BG Michael Talley and CSM Victor Laragione, GEN Murray was treated to a front row seat for a prolonged field care scenario, executed by our subject matter experts in the MMSIV and MedRAS divisions. Demonstrating the latest in TATRC research and lines of effort, the scenario highlighted multiple technologies including the Mobile Multiple Mission Module (M4), the CAMIC device, 3D mapping, and our NEXUS lab's motion capture capabilities! Additionally, GEN Murray was able to get hands-on with our VR-controlled telesurgical robot for a simulated procedure, assisted remotely by MAJ Steve Hong, MD, WRNMMC!

General Murray was enthusiastic about TATRCs research on the fusion of humans, data and technologies noting that these "soldier-centered efforts are essential for research and development of future military medical innovations."

The Team was excited and grateful for the opportunity to highlight the important work we're doing for GEN Murray.

GEN John M. Murray, Commanding General of Army Futures Command, gets a robot's eye view during our telesurgical robotics demo!

More than 30 Senior NCO's watch as TATRC's MMSIV team runs a live training scenario!

TATRC didn't have long to wait before the next group of guests were up to the plate! We had the exciting opportunity to host the Senior NCO Leadership group for a demonstration and briefing, with more than 30 Senior NCO's in attendance, including CSM Michael Gragg of the Defense Health Agency!

Our Science Director, Mr. Matt Quinn, our MMSIV Division Chief, Mr. Geoff Miller, Mr. Zach Buono and Mr. Ethan Quist of our MedRAS Division, and our incredible medics and Sim Team were

TATRC Commander, COL Jeremy Pamplin, briefs AFC CSM Michael A. Crosby on a simulated escharotomy procedure!

CSM Crosby sees just how realistic simulated scenarios can be!

all on hand to lead the group through a scenario which demonstrated the latest in TATRC technology and innovative initiatives, including our NEXUS simulation space, our TRON telesurgical robotics project, the Mobile Multiple Mission Module (M4), and much more!

The event was a resounding success, with high levels of interest and many excellent questions coming from these NCO's.

With regards to the importance of hosting this particular group, Mr. Geoff Miller said, "I get very excited about the work we're doing, and it's all the more valuable when we're able to connect with and get feedback from a group as close to the operational ground troops as these NCO's are."

We couldn't be happier to be hosting these visits on our campus once again, and we're especially grateful to CSM Victor Laragione for helping to coordinate the opportunity to talk to these NCO's!

We were very thankful for this group spending their morning with us, and for their insightful feedback.

Rounding out our trio of VIP visits, the Team had the immense pleasure of hosting CSM Michael A. Crosby, of Army Futures Command for a tour and briefing at the TATRC campus, who was eager to see it for himself after the successful and productive visit with GEN Murray. It was another fantastic opportunity to highlight the important work being done as it relates to prolonged field care at TATRC, and another step forward for Project Convergence!

Following an introductory briefing from key TATRC staff, CSM Crosby was immersed in a simulated PFC scenario and introduced to the various projects and technologies that we are testing and developing on a daily basis! Technologies demonstrated included high-fidelity mannequins, motion capture cameras, moulage, 3D mapping, and autonomous evacuation and robotic perception!

Our thanks to CSM Crosby for his time and interest in helping us to forge the future of military medicine!

TATRC Bids Farewell to Outgoing Commander, MG Michael J. Talley

Always a spirited advocate for TATRC, MG Talley was instrumental in setting TATRC on the path toward becoming our own independent Command

The late General Colin Powell once said, "…Soldiers watch what their leaders do. You can give them classes and lecture them forever, but it is your personal example they will follow." We could think of no better quote to sum up the past two years spent under the dedicated, inspiring, and insightful leadership of USAMRDC Commanding General, Michael J. Talley.

Having joined the Army as an enlisted combat medic over thirty years ago, MG Talley's unique perspective on leadership shines through in every interaction you have with him. Through his quarterly briefings and frequent in-person visits to the TATRC campus, his personal example as Commander has inspired each and every member of our organization for the past two years of his tenure. During the pandemic, when teams were pushed to new limits across the MRDC command, MG Talley was there every step of the way, leading by example and putting in the work that saw the Command effectively become the main effort for the Army in the fight against COVID-19.

Team TATRC is especially grateful for MG Talley's recognition and appreciation of the work we do in support of the Warfighter. We received his steadfast backing and support of our mission during a transformative time in our organization and it has no doubt attributed to the successes we have since achieved. Notably, MG Talley was instrumental in setting TATRC on the path toward becoming our own independent Command. He has been one of our strongest allies and we are forever grateful for his guidance and advocacy.

From each of us here at TATRC, we sincerely thank you for your leadership, Sir and wish you all the best as you serve in your new role as the Deputy Commanding General for OPS at the Office of the Surgeon General. Godspeed, MG Talley.

TATRC Participates in MRDC's Change of Command

The morning of 22 June marked yet another major milestone for the USAMRDC, as MG Michael J. Talley welcomed the incoming Commanding General, BG Anthony McQueen, during MRDC's Change of Command Ceremony! This year's ceremony, which took place indoors in the new auditorium with Troops in formation, featured a large audience with distinguished guests and attendees from all units and labs, including our own Commander, COL Jeremy Pamplin, who was honored to participate in this traditional military event.

The USAMRDC Change of Command featured a large audience with attendees from all units and labs

The event was officiated by Gen. John M. Murray, Commanding General of the U.S. Army Futures Command.

After the official passing of the flag, Murray offered his thoughts on the accomplishments of USAMRDC.

"While most people don't understand MRDC's history, and while most Americans won't understand what this Command has accomplished over the years, the impact of this Command is felt worldwide," said Murray.

BG Anthony McQueen addresses the crowd as he accepts command of the USAMRDC

For the past two years, MG Talley has presided over the Command with dedicated, dutiful, and highly respected service. In what has proven to be a historical and unprecedented time, not just for Army medicine, but the world at large, MG Talley was precisely the leader we needed to continually guide our complex and diverse Command to success time and time again. There is no doubt that thanks to his tireless efforts and superb leadership, the USAMRDC Team is perfectly positioned for success in the coming years.

And what better way to reward the hard work that went into that success, than to continue to build on it as the organizational reigns are handed over to BG Anthony McQueen! Having most recently served as Deputy Chief of Staff, G-3/5/7 for the United States Army Medical Command, BG McQueen is a well-suited and deserving choice to lead and continue the legacy of excellence our Command embodies. The future is bright for Military Medicine, and we are honored to be part of the team that will continue forging toward that future under the venerable leadership of BG McQueen!

Team TATRC extends a hearty welcome and congratulations!

TATRC Welcomes New Commanding General, Anthony McQueen to MRDC!

Team TATRC is proud to extend a warm welcome to the newest USAMRDC Commanding General, BG Anthony "Tony" McQueen! Having most recently served as the Deputy Chief of Staff, G-3/5/7, U.S. Army Medical Command, and Director, Health Care Operations, Office of the Surgeon General (OTSG), his newest appointment is a fitting addition to an impressive résumé!

BG McQueen began his military service after graduating from Fort Sam Houston State University in Texas – the state in which he was born and raised – where he was commissioned as an ROTC Distinguished Military Graduate in 1991. A graduate of the Army Medical Department Officer Basic Course, he also has completed the Combined Logistics Officer Advanced Course, the Command and General Staff College at Fort Leavenworth, Kansas and the National War College. He holds a Master of Science in National Security Strategy and a Master of Arts in Health Services Management.

BG Anthony McQueen, USAMRDC Commanding General

Like his predecessor, he is a veteran of Operation Iraqi Freedom. He has also completed two tours in the Republic of Korea with the 2nd Infantry Division, and has held key leadership positions at the Medical Brigade and Brigade Combat Team levels, Division Staff, U.S. Army Medical Center of Excellence and the Office of the Surgeon General. McQueen has commanded at every level, from company through brigade at multiple stations around the world.

Team TATRC is thrilled to have such a distinguished and accomplished Commanding General taking the reins!

DHIC Division Chief Delivers Keynote Speech to Graduate Students

This past April, Ms. Jeanette Little, Division Chief for TATRC's Digital Health Innovation Center (DHIC), delivered a virtual presentation as the closing keynote speaker to graduate students from the Johns Hopkins University and Augusta University. Ms. Little's presentation was part of an annual workshop intended to bridge the gap between industry and academia as graduate students in both organizations begin to think about their careers after graduation. Ms. Little's keynote presentation was entitled, "Over the Horizon: A Look at What's Coming" and focused on military medical technologies and innovations. The TED-talk style presentation focused on the impact that the military has had on medical practice and education in the recent past, and the potential future impact that current Medical Assist Support Technologies portfolio research will have in generations to come. Advanced wearable technologies, augmented reality, artificial intelligence, medical robotic assist tools, and unmanned vehicles were all highlighted during her forward thinking keynote.


Ms. Jeanette Little, DHIC Division Chief

Ms. Little stated, "Graduate students are always concerned that they need to know 'everything' in order to be competitive when they enter the job market. While I certainly don't have a crystal ball, it's clear that the medical interfaces and resources will be different in the future, and that is change we should all embrace. My goal was to reassure the students that I spoke to, that it's really a lifelong journey of learning, adapting and being open and accepting of change that makes you competitive in the workplace."

COVID-19 Airway Management Isolation Chamber "CAMIC" Team Selected for Prestigious Technology Transfer Award

A multi-disciplinary team of scientists, engineers, and doctors who invented the COVID-19 Airway Management Isolation Chamber, or "CAMIC," was selected to receive a 2021 Excellence in Technology Transfer Award from the Federal Laboratory Consortium for Technology Transfer (FLC). The FLC is the congressionally mandated organization that educates, promotes, and facilitates Federal Technology Transfer. This highly competitive award is presented annually to laboratory employees who have accomplished outstanding work in the process of transferring federally developed technology. The CAMIC Team was also given the distinction of being a COVID-19 Response Award winner as well!

TATRC's own Mr. Nathan Fisher, Chief of the Medical Robotics and Autonomous Systems Division was one of the lead inventors and contributors for CAMIC. The team was recognized by the FLC during the award ceremony which took place on April 8th. The FLC Award stated, "The CAMIC is a clear isolation chamber that drapes around the head, neck and shoulders of a patient, creating a portable negative pressure environment that captures and removes viral particles using vacuum lines. CAMIC was conceived in the Spring of 2020 by physicians at Walter Reed National Military Medical Center (WRNMMC) and refined in just three weeks with the support of three Army labs: the Telemedicine & Advanced Technology Research Center (TATRC), U.S. Army Medical Materiel Development Activity (USAMMDA) and the Clinical and Translational Research Program Office (CTRPO). CAMIC's simple construction from readily available materials allowed for the rapid fabrication of the chambers by military treatment facilities after the Food and Drug Administration (FDA) granted an emergency use authorization in June."

The FDA emergency use authorization allowed CAMIC schematics and instructions to be shared with military treatment facilities (MTFs), allowing staff to fabricate their own devices using locally sourced materials as a supplement to PPEs—including at an MTF in Afghanistan and medics in the field. CAMIC also was used to conduct the Department of Defense's first COVID-positive surgery at WRNMMC, protecting medical staff and resulting in no additional infections. This simple, yet innovative invention helped rapidly place technology in the hands of the Warfighter and the medical personnel tasked with treating them.

CAMIC in use after FDA Emergency Use Authorization

"The speed at which this diverse and multi-organizational team came together and began achieving results was truly remarkable," stated Mr. Fisher. "This is a massive credit to Dr. Steven Hong for sharing his vision and leading the team through many hurdles without losing stride to meet an emergent need during the COVID-19 crisis."

The CAMIC was recently featured as one of many MHS innovations in the battle against COVID-19 in a health.mil article, which can be found at: https://health.mil/News/Articles/2021/01/05/MHS-operational-innovations-continue-in-battle-against-COVID-19.

Congratulations to Mr. Fisher, and the entire CAMIC Team, for working together in partnership on this well-deserved recognition and award!

For more information on this project, please contact Mr. Nathan Fisher, nathan.t.fisher3.civ@mail.mil.

TATRC MedRAS Partners with Navy in 1st Ever Telerobotic Surgery Summit

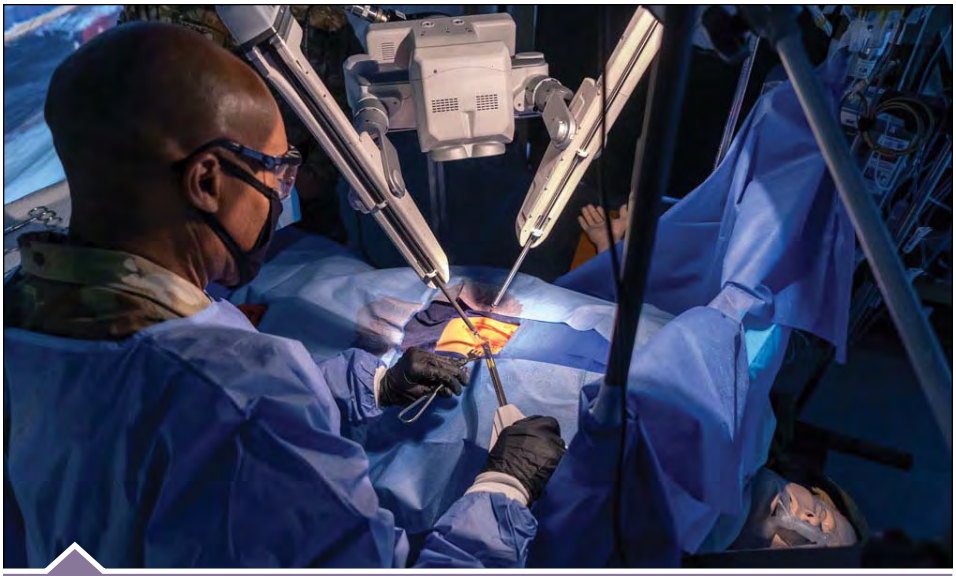
May 2nd marked the Inaugural TeleRobotic Surgery Symposium, a virtual event for Department of Defense stakeholders in Telemedicine, Telementoring, and Telesurgery. The symposium was chaired by CAPT Gordon Wisbach, Staff General Surgeon at the Naval Medical Readiness and Training Command San Diego (NMRTC-SD) and co-chaired by TATRC's Medical Robotics & Autonomous Systems Division Chief, Mr. Nathan Fisher. Attendees joined virtually from all across the country and from all branches of Military service including representatives from Army Futures Command, NMRTC-SD, Air Force Medical Readiness Agency, Defense Health Agency (DHA), Defense Advanced Research Projects Agency (DARPA), and the Defense Innovation Unit (DIU).

The goal of this inaugural symposium was to foster a community within the DoD with shared, common interests in advancing telesurgery

The goal of this inaugural symposium was to foster a community within the DoD with shared, common interests in advancing telesurgery and to begin discussions focused on developing a mutual strategic roadmap for government research teams to advance telehealth capabilities and telerobotic surgery research. A total of twelve guest speakers delivered various presentations throughout the full-day symposium, sharing their own unique perspectives and experiences on researching telehealth within the DoD. TATRC Director, COL Jeremy Pamplin kicked off the symposium describing the history of telesurgery and the challenges we will encounter in the future operating environment, which set up the key questions for the day - "where are we going" and "how do we get there" for telerobotic surgery.

The keynote speaker was Dr. Mehran Anvari, a well-known pioneer and early champion of telerobotic surgery, and the creator of the first telerobotic surgical service between a teaching hospital and a remote site. In his presentation entitled "Tales from a Pioneer in Telesurgery," Dr. Anvari spoke about the beginnings of telesurgical research and the first successful remote telerobotic procedure he conducted. He continued to explain the challenges of robotic surgery research in the early 2000's and where the future needs to focus to continue telesurgery research going forward. Dr. Anvari was followed up by MAJ Steve Hong from Walter Reed National Medical Center who presented on the "Current State of Robotic Surgery in DoD." Dr. Hong detailed the prevalence of robotic surgery and current uses in the Military Health System. He described the growth within both the MHS and the civilian medical sector for surgical robotic platforms and illustrated how the future of hospital robotics is going to be designing the robotics to be smaller and more cost effective.

To answer the "where are we going" portion of the symposium's mission, Mr. Nathan Fisher presented on the topic of "TeleRobotic Surgery – Technology Landscape and Notional Roadmap." After detailing a brief history of surgical robotics research and illustrating TATRC's long



It was important to hold the symposium now, as we begin another momentous time for telerobotic surgery technologies

history as a partner for many telerobotic surgical research efforts, Mr. Fisher noted that throughout that history there are two major inflection points. The first in the late 90's with the advancements and fusing of fiber optics with robotic control allowing, for the first time, the possibility of remote telerobotic surgery. The second technology inflection point is happening right now with the advancements of human-machine interfaces, 5G telecommunications technologies, and Artificial Intelligence (AI). That is why it was so important that the DoD hold this symposium at this critical point at the beginning of another momentous time for telerobotic surgery technologies. Mr. Fisher then laid out what the goals and roadmap will be for the DoD in telesurgery. Phase I will establish a foundation within the Military Health System of surgical telementoring capabilities. Dr. Wisbach and NMRTC-SD have already begun work on an IRB-approved telementoring project to launch this phase. Phase II will build the telerobotic surgery infrastructure on top of the foundation of telementoring established in Phase I. Expertise and experience of a surgeon will extend from telementoring into direct remote teleoperation by expanding the existing communication channels and networks for telerobotic surgery. Lastly, Phase III will extend the care of an expert surgeon within the MHS to remote sites in austere and pre-hospital locations by advancing emergent technologies in telecommunications (5G) and AI to alleviate latency barriers and automate assistive surgical behaviors.

To help answer the "how do we get there" portion of the symposium's mission, CAPT Gordon Wisbach spoke in his "Surgical Telementoring" presentation about his work at the Navy Medical Center in San Diego. In a collaborative project with industry partner, Intuitive Surgical, Dr. Wisbach is developing technologies to extend the expertise of the expert surgeon to remote locations and understaffed care facilities. The brainpower of the telementoring capabilities reside in the brand new Virtual Medical Operations Center (VMOC) within the Navy Medical Center, a first of its kind in the DHA. Serving as a central hub, the VMOC can extend expert care to hundreds of patients by state of the art telemedicine and telementoring technologies. The first steps of the telementoring project are to establish reliable communication with bi-directional audio and 3D video. Then, the goal is to demonstrate effective telestration with virtual tools or 'ghost tools' during surgical procedures. Lastly, the telementoring project will develop enhanced capabilities through Machine Learning and analytics. This work, already underway at the NMRTC-SD , marks the start of Phase I of the TeleRobotic Surgery roadmap and the beginnings of foundational work for the path ahead.

The remainder of the symposium was filled with insightful and inspiring presentations from guests all across the DoD and other federal agencies.

The information sharing and networking that occurred during this event fulfilled the first goal of the symposium by helping to foster growth within the DoD community interested in the long-term goal of telerobotic surgery. The next steps are to solidify the Telesurgical roadmap and begin executing Phase I action items, which can start immediately or in some cases are already underway.

"This inaugural symposium is an important first step in establishing a federal 'Community of Interest' to define a shared vision and technology development roadmap for TeleRobotic Surgery spanning near, mid, and far term time horizons. Thank you to our distinguished speakers who shared their valuable insights and to the numerous stakeholders in attendance. Working together, we will forge the future for telerobotic surgery to improve surgical care of patients," stated Mr. Fisher.

A follow on meeting is being planned for the fall of 2021.

For more information on this project, please contact Mr. Nathan Fisher, nathan.t.fisher3.civ@mail.mil.

NETCCN Drives on to End COVID and Evolve for All-Hazards and Multi-Domain Operations (MDO)

With the award of the second phase of the National Emergency Tele-Critical Care Network (NETCCN) project, the four NETCCN performer teams have begun to receive additional clinical assignments and establish the systems, processes, and governance to operate as a scalable network or ecosystem.

While NETCCN was developed to address the extension of critical care expertise to places struggling to care for severely-ill COVID-19 patients, NETCCN's light-weight technology and care model is also well-suited to address other challenges related to bringing expertise to the point of need, whether in rural America, in a location experiencing a disaster, or on far-flung multi-domain operation (MDO) battlefields.

TATRC and its partners at the U.S. Department of Health and Human Services Assistant Secretary for Preparedness and Response (HHS/ASPR), Society of Critical Care Medicine (SCCM), and U.S. Army Institute for Surgical Research (USAISR) are working closely to identify and apply NETCCN capabilities and resources to address a variety of new and emerging challenges, scenarios, and models of care.

For example, TATRC and its NETCCN performer team Avera, are working with Community Health IT, a not-for-profit based in Florida, to bring NETCCN to a group of ten critical access hospitals (CAH) in the state – both for addressing current COVID care needs and for addressing future use during a hurricane, disaster or other potential surge situations. The Avera team is also working with Community Health IT to incorporate NETCCN into telehealth apprenticeship training for staff and healthcare organizations in the state.

The Geneva and Avera NETCCN teams have initiated missions to incorporate NETCCN into Emergency Medical System (EMS) training and care models in St. Louis, MO and Florida, respectively. These missions will allow TATRC and its partners to collect important data to quantify acceptance of NETCCN by EMS teams and other stakeholders, as well as assess the value of NETCCN to EMS care.

Additionally, the NETCCN Deloitte team has initiated pilot projects to incorporate NETCCN into specialty care networks for burns and ECMO (extracorporeal membrane oxygenation) in Texas. These projects seeks to leverage NETCCN in support of organizations' specialty burn and ECMO referral missions and demonstrate that a multiple hub, multiple spoke network for specialty care is viable and valuable.

TATRC has also assigned the NETCCN Deloitte team to incorporate Defender Pacific, a military exercise of austere casualty care across the Pacific Rim. Working with the Defense Health Agency's (DHA's) Joint Tele-Critical Care Network (JETCCN), we plan for NETCCN to be loaded onto an unlocked Nett Warrior Device and/or personal or provided Android devices to allow patients to be registered by local caregivers before injury, to project expertise to the point of injury, and to share information about casualties from the point of injury to higher echelons of care during movement and to demonstrate that data entered on NETCCN locally in a Denied Environment (i.e. no network access) can then be synchronized to the cloud once communications are re-established.

Identifying, onboarding, initiating and tracking these and future NETCCN missions across the NETCCN ecosystem requires a high level of coordination and the establishment of governance models and systems for working across performer teams, federal agencies and other partners. The NETCCN Expression Networks team and TATRC Operations Team are working with an array of stakeholders to refine and establish these models and to automate them to the extent possible.

Mr. Matt Quinn, TATRC's Science Director, stated, "It's a huge challenge and a testament to the hard work, ingenuity, creativity and resourcefulness of all of the wide array of people who have worked tirelessly together to create the NETCCN and continue to evolve it into an ecosystem capable of an array of missions, civilian, military and somewhere in between!"

Science Director's Corner:

Applying Lessons Learned from TATRC's COVID Work to MDO

Mr. Matt Quinn,
Science Director, TATRC

Last March - which seems like a decade ago - is when TATRC received the call from the Army Medical Research and Development Command's (MRDC) Commanding General inquiring about how TATRC could help with the fight against COVID-19. The Nation at the time was embarking on a situation in which the number of people infected and requiring intensive care was skyrocketing and overwhelming caregivers across the country, in both urban places like New York City and rural ones.

In many cases, the sheer volume and severity of COVID-19 cases and the inability of critical access hospitals (and in some cases EMS providers) to move patients to higher levels of care resulted in hospitalists, nurses and other caregivers doing de-facto critical care medicine for extended periods of time, without adequate staff, or the ability to quickly evacuate.

If this echoes the kinds of challenges that medics and other caregivers experience during combat casualty care on the battlefield, then it should. And the tyranny of time and distance and the lethality of enemy weapons in MDO will make the Golden Hour of moving casualties to a higher level of care less possible.

In other words, for both COVID and MDO, we need a plan to bring the appropriate clinical expertise to the point of injury and to do it in a way that is nearly instant, that can operate in low bandwidth environments and in a way that does not require additional hardware. For roughly the past year, TATRC – with an array of public and private partners – has accelerated the NETCCN project from concept to reality both to support actual COVID care to places like Puerto Rico, Guam and the Upper Midwest, but also to test out and refine these concepts, technologies and governance models. Since then, we've learned a ton! TATRC has also begun to incorporate NETCCN into military exercises like CyberQuest, Defender Pacific and Project Convergence and pilots and use in the Military Health System (MHS), as well as the military-civilian National Disaster Medical System (NDMS).

The second phase of NETCCN is focusing on building a multi-platform NETCCN ecosystem, which requires NETCCN teams to work together, incorporation of a Cross-Platform Application Module (C-PAM) to bridge capabilities, data and situational awareness across NETCCN platforms so that the NETCCN can scale to the regional and even national level for the pandemic and for future response.

The "virtual hospital" portion of our COVID work builds remote, autonomy and device interoperability of devices, including medical devices, into the NETCCN ecosystem to expand the capabilities that remote experts can deliver to the point of need.

MDO will require a similar ecosystem-approach and the need to bridge heterogeneous applications, tools, devices, sensors and data sources. In many ways, the NETCCN ecosystem is a microcosm of the broader intelligent medical integrated, intelligent medical ecosystem (I2ME) and facilitates manned and unmanned teaming, autonomy, and resilient "meshed" systems that share resources and responsibilities.

The I2ME decreases the human burden of casualty care, expands capacity, and increases the lethality of the force. Local, non-networked AI systems maintain support for well-trained caregivers when communications are not available. Increased network and power resources and consistency in strategic areas allow increased tele-solutions and remote control. The system enables human capital to be increasingly pushed to the edge where network and power are least reliable.

While the genesis and funding of NETCCN arose from COVID, our work has direct applicability to the challenges of MDO and military medicine.

EMPLOYEE SPOTLIGHT

Congratulations to TATRC's Hard Working Multi-Media Coordinator, Mr. Brandon Grimes!

TATRC extends a heartfelt Congratulations to our Q3 Employee of the Quarter, Mr. Brandon Grimes. Brandon, the Multi-Media Coordinator in TATRC's Marketing & Public Affairs group, is an exemplary employee, whose "can do" spirit is evident in everything he tackles. His commitment to TATRC's many and evolving missions has been unwavering, and the execution of his tasks and responsibilities has been significant and done with a positive willingness.

The amount of work that Brandon has recently taken on and produced in his time here is commendable. When the COVID-19 pandemic hit, there was an immediate need for increased communications and helpful ways to aid in keeping our staff connected. Brandon realized this gap, and stepped in to implement creative solutions to achieve this. Some of these solutions included a method for all TATRC staff to be able to virtually attend the Director's Quarterly Town Halls. Brandon found a new way to live stream those Town Halls into a closed broadcast so that the Fort Gordon team, as well as the BHSAI staff and any other TATRC staff off-site, could participate and be a part of these important gatherings. Brandon also created a comprehensive visual Staff Directory that was complete with headshots, titles, phone numbers, and email addresses of every member of the team, which has been especially useful as we all continue to be out of the office and off-site working remotely.

Mr. Brandon Grimes, Multi-Media Coordinator for TATRC's Marketing & Public Affairs.

Most recently, Brandon quickly created and produced a 3-minute NETCCN introductory video to help educate and inform external stakeholders about this critical initiative and has also developed a second testimonial NETCCN video, which included interviews from the field.

He has also become a bit of an 'IT expert' and has facilitated numerous presentations, briefings, and "virtual" retirement, as well as a promotion ceremony.

Brandon is also behind the scenes on much of TATRC's Social Media in the background day-to-day. Brandon has been responsible for increasing our followers by 150% per year since he began!

Beyond the projects that stand out, Brandon also is an unsung hero who steps in to help the rest of the PAO team at a moment's notice, and always with a smile on his face. He's often reaching out to others on the PAO team to see how he can help, or what he can contribute to our various projects. He's a team player who always says "yes" to helping others and finds "innovative" and unique ways to help solve problems.

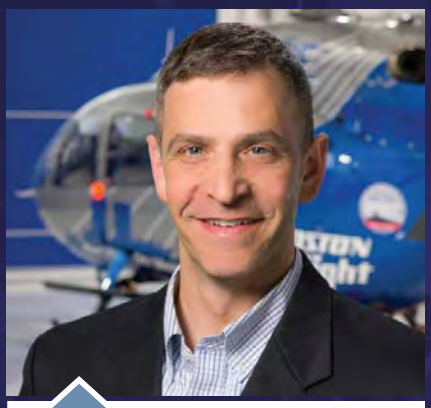
Congratulations Brandon, on this well-deserved recognition! !

US Army Reservist Joins Team TATRC!

TATRC is thrilled to welcome COL Jason Cohen, DO, FACEP, FCCM, to our continually evolving and diverse team! COL Jason Cohen is a US Army Reservist and is serving as the Individual Mobilization Augmentee (IMA) at TATRC.

Dr. Jason Cohen is an emergency medicine, critical care, and EMS physician in Boston, Massachusetts. He also serves as the Chief Medical Officer (CMO) at Boston MedFlight, a nonprofit critical care transport program, transporting the most critically ill and injured patients in and around New England by helicopter, airplane, and ground ambulance. In addition to his position as CMO, Dr. Cohen practices medicine in the Burn, Trauma, and Surgical ICU's at Brigham and Women's Hospital. After working as a paramedic for a number of years, he received his medical degree from the University of New England College of Osteopathic Medicine. Dr. Cohen brings more than 25 years of health care experience to the position, including providing disaster care as a physician with FEMA. COL Cohen also brings 20 years of military medical experience in both the Reserve and Active components of the United States Army, having deployed as an Emergency Physician with the 86th Combat Support Hospital (CSH) in support of Operation Iraqi Freedom, and as Chief of Emergency Medicine with the 325th CSH in support of Operation Enduring Freedom, and 349th CSH in support of Operation Spartan Shield.

When not caring for their flocks of chickens and ducks, in his spare time, COL Cohen can be found exploring the outdoors with his wife and four children. They enjoy hiking, backpacking, and kayaking as a family throughout the Northeast, and skiing when the winter sets in.



COL Jason Cohen, DO, FACEP, FCCM

COL Cohen comes to TATRC to serve as a resource, providing much needed additional clinical perspectives and end-user input to the multiple teams.

We here at TATRC are grateful for this knowledgeable and wonderful new resource! Welcome COL Cohen!

TATRC's First Nurse Scientist Joins the Organization!

Spring was certainly in full bloom with new faces popping up all around TATRC! The organization was pleased to welcome Major Patty Schmidt, PhD., RN, who joined TATRC as our first Nurse Scientist!

Most recently, MAJ Schmidt served as a Nurse Scientist and Deputy Chief of Research at the Center for Nursing Science and Clinical Inquiry within the Tripler Army Medical Center in Honolulu, HI! Prior to that, she was stationed at Brooke Army Medical Center in San Antonio.
Her research has focused on moods and the emotions of nurses, how it spreads in a work environment and the impact this has on patient care. MAJ Schmidt has also been the site PI and associate investigator for various Army nursing studies conducted in Army medical centers. She is the Data Analytics and Research Team leader for the National Emergency Telehealth Critical Care Project.

Major Schmidt has been an Army Nurse for 16 years. She obtained her BSN at Marquette University and earned a PhD in Nursing from Uniformed Services University of the Health Sciences. She deployed to Iraq for 15 months as a critical care nurse and her clinical specialty is burn care.

This busy mother of 3 is no stranger to multi-tasking and will support all of the TATRC divisions as needed in her role under the direction of our Science Director, Mr. Matthew Quinn.

MAJ Patty Schmidt, PhD., RN, Nurse Scientist.

TATRC is excited to welcome MAJ Schmidt to our growing organization!

EMPLOYEE SPOTLIGHT

TATRC Welcomes New Robotics Research Engineer to the MedRAS Division

Jaeyeon Lee, Ph.D., has joined TATRC's Medical Robotics & Autonomous Systems (MedRAS) Division as an ORISE Digital Health Fellow. His research background in robotics, coupled with his experience in developing microsurgical robot systems will assist in the improvement of the motion planning, control, and human-in-the-loop teleoperation performance of the robot systems at TATRC in order to care for the casualties on the battlefield. He will also provide knowledge about robotic assistance during surgery based on his previous collaborations with various medical professionals. His research background includes microsurgical robots, micro/nanorobots, robot haptics, and closed-loop teleoperation systems. He is particularly interested in modern AI technology for smart robot systems closely working with humans.

Dr. Lee grew up in a small town in South Korea and has loved robots since his childhood. His hobby growing up was to build robots with whatever materials he could get his hands on. He joined the Robotics Club during his sophomore year of high school and it was that which inspired him to become a professional roboticist. After getting a Master's degree in South Korea, he embarked on a journey across the seas to continue his studies in Texas. He received his Ph.D. in the Department of Electrical Engineering from the University of Texas in 2016. He briefly joined the medical school of the University of Texas Health Science Center at Houston as a Sr. Research Associate, then later became a Sr. Control Engineer in ColubrisMX Inc. in 2017. With three years of industrial hands-on experience under his belt, he returned to the research field to conduct studies on the rapidly growing technology of robotics systems. From 2020, he conducted his research on telemedicine, microrobots, and machine learning in the Department of Biomedical Engineering at the George Washington University before joining us here at TATRC this year.

Dr. Lee believes technology makes the world a better place and saves human lives. He considers himself to be an idealist as a roboticist at times. Additionally, Jaeyeon enjoys traveling, walking, and tinkering in automobile mechanics in his spare time.

Dr. Jaeyeon Lee, Ph.D, Medical Robotics & Autonomous Systems (MedRAS) Division, ORISE Digital Health Fellow.

TATRC is super excited to welcome Dr. Lee to the growing MedRAS Division!

TATRC Welcomes Back A Familiar Face!

The TATRC Team is thrilled to welcome back Dr. Jeffrey Stephenson, a Research Compliance and Clinical Coordinator that will be serving as the Regulatory Compliance Specialist in our growing Science Cell.

Under TATRC's Science Director Mr. Matt Quinn, Dr. Stephenson will act as the subject matter expert tasked with developing, implementing and managing TATRC's regulatory compliance efforts, in addition to providing day-to-day regulatory guidance to and support for Principal Investigators and other TATRC personnel.

Dr. Jeff Stephenson is no stranger to military medical research efforts and has spent over a decade working as a contractor in the USAMRDC, including working for the U.S. Army Medical Research Institute of Infectious Diseases, the Office of Research Protections Human Research Protection Office, and finally, for TATRC in a similar capacity from 2006 - 2014, focused primarily in medical modeling and simulation technologies, mobile and health IT, prosthetics research, Alzheimer's and Parkinson's research, and small business innovative technology studies. Jeff also holds a doctorate in philosophy from the City University of New York and since 2012, has had an appointment in the Department of History and Philosophy at Montana State University lecturing in ethical theory and social and political philosophy, while also working periodically as a regulatory consultant in clinical research.

Jeff divides his free time amongst hiking and mountain biking in western Montana with his hospitalist wife and two dogs; blacksmithing and welding in his shop; and taking care of three sheep, ten goats and four chickens on their small rescue ranch.

Dr. Jeffrey Stephenson, Regulatory Compliance Specialist

TATRC gives a warm welcome back to Dr. Jeffrey Stephenson!

Science Cell Adds NETCCN Liaison Officer to its Team

Mr. Mike Reinemann has joined TATRC's expanding Science Cell as the NETCCN Liaison Officer! In this new role, Mike will facilitate programmatic communications between the government and external stakeholder teams developing a national emergency telemedicine critical care network in support of COVID-19 and future emergency use cases. As a virtual health / NETCCN liaison officer, he will provide advice to senior leadership and develop content with cross-functional teams ensuring seamless communication internal to the organization, and with external stakeholders.

Mr. Mike Reinemann, NETCCN Liaison Officer.

Mike has a BS in Biology and Master's in Public Health, with 13 years of experience working in biotechnology, initially in molecular biology research, and more recently in product management, marketing and business development of various in vitro diagnostic products. He has extensive international business experience, and has led successful product development, registration, and commercialization efforts all over the world. Mike considers himself a business scientist who prides himself on being a subject matter expert in whatever product he is working on.

On a personal note, Mike's hobbies include lots of outdoor activities like hiking, fly fishing, skiing and snowboarding. He is originally from New Jersey and is a NY Giants and Yankees fan, but has adopted the Caps as his local hometown pro team.

Welcome to TATRC, Mike!

DHIC's FOXTROT Used for Optometric & Ophthalmologic Training at USUHS

20 senior military opthalmologists and optometrists trained with the FOXTROT platform during the Ocular Trauma Course at USUHS this past May!

The FOXTROT platform (provider portal and accompanying mobile application) was incorporated into a training session during the Ocular Trauma Course at The Uniformed Services University of the Health Sciences (USUHS) in Bethesda, MD this past May.

The audience consisted of 20 senior military ophthalmologists and optometrists from throughout the country. In conjunction with Dr. Kevin Jackson OD MPH CDR (Ret.), MSC USN, Chief of Staff at USUHS, TATRC's Digital Health Innovation Center (DHIC) Division developed a brand new instance of FOXTROT on the Mobile Health Care Environment – Research (MHCE-R) development system to facilitate this training. Users were granted secure access to the web portal and selected users were also granted access to the accompanying application to send and receive synthetic consult case requests for this training activity. The MHCE-R development system contains no live research data and it lends itself to this instance nicely.

The FOXTROT platform provides a secure HIPAA-compliant tool that connects the providers at the point of injury, regardless of their location, to an assigned ophthalmologic specialist at a higher level of care. Providers can be assigned depending on the on-call schedule for each location or facility. FOXTROT leverages TATRC's MHCE-R and its accompanying mobile app, mCare, as a solution to treat ocular trauma. As has been previously reported in prior editions of the TATRC Times, FOXTROT was successfully deployed to Afghanistan in 2019, and in August 2020, those findings were published in JAMA Ophthalmology.

Since October of 2020, FOXTROT is further transforming virtual consults for two additional ophthalmology specialists at Joint Base Andrews Emergent Care Center (ECC), replacing traditionally employed consult mechanisms. On average, these ophthalmology specialists currently receive 3-5 consults per week, with a maximum of three consults received in a given day. FOXTROT is also expected to expand to Portsmouth Naval Hospital and its outlying optometry clinics, as well as to Brooke Army Medical Center to augment their ophthalmology specialist's consult response capabilities.

Ms. Mabel Cooper, a project manager with DHIC stated, "What I am most proud of is the flexibility of the FOXTROT portal and application. This technology has proven useful and usable in OCONUS settings in Afghanistan and CONUS at the Andrews ECC. We are continuously working with our TATRC partners to enhance and refine the existing FOXTROT capabilities and are looking towards incorporating secure video consultation over the .mil environment. Stay tuned for more on that throughout the upcoming year."

For more information on this project, please contact Ms. Jeanette Little, jeanette.r.little.civ@mail.mil.

TATRC Research Nurse Trains at Walter Reed for Prolonged Field Care

The Fundamentals of Critical Care Support (FCCS) – Resource Limited (RL) was a 2-day course held in March of this year and was hosted at the Walter Reed National Military Medical Center in conjunction with the Uniformed Services University of the Health Sciences (USUHS) in Bethesda, Maryland. TATRC's Research Nurse, Ms. Holly Ortman, from the Medical Modeling, Simulation, Informatics and Visualization (MMSIV) Division was invited to take part in this highly informative course and training event.

The course is designed to expose credentialed health care providers to a restricted resource environment and familiarize themselves with providing care to critically ill or injured patients in austere settings. Using the minimum-better-best pathways, clinicians were encouraged to practice resource management and allocation, appropriate patient triage and care, and ethical considerations during mass-casualty situations. The course builds on caregiver's medical experience, skills, and knowledge of available assets and resources to guide treatment and evacuation plans. It also leverages and encourages telemedicine use for clinical decision making support and procedural guidance when transport or evacuation is delayed or unavailable.

Attending this valuable course provided Ms. Ortman with new knowledge that will assist the MMSIV Division to craft and tailor simulation scenarios to better prepare and familiarize Warfighters with emerging technologies designed to support clinical decision making in forward operating environments. Integrating these situational facts into research allows the MMSIV team to continuously evolve and continue expanding the immersive simulation environment.

This strategic knowledge and training aligns with TATRC's mission and vision of incorporating advanced ground-breaking technology to address and prepare for capability gaps within military medicine. Ms. Ortman stated, "Attending the training was incredibly beneficial to better understand the environment our Warfighters are sometimes forced to operate in.

TATRC's Research Nurse, Ms. Holly Ortman, from the Medical Modeling, Simulation, Informatics and Visualization (MMSIV) Division took part in this highly informative course and training event.

Assimilating this new information into simulation environments will assist the MMSIV team in developing enhanced training and data collection scenarios aimed at providing real-life learning opportunities for our Warfighters.".

TATRC TRIVIA

Answer from Previous TATRC Times Issue:

Question: In honor and recognition of Women's History Month, can you name TATRC's first and only female Chief of Staff?

Answer: Ms. Cheryl Merritt is TATRC's first and only female Chief of Staff.

TATRC Presents at NATO Kickoff Meeting for the Development & Implementation of Autonomous Transport Medical Systems for Casualty Evacuation

On 20 April, Mr. Nathan Fisher, TATRC's Chief of the Medical Robotics and Autonomous Systems (MedRAS) Division, presented at the kickoff meeting for the NATO Research Task Group (RTG) for Human Factors in Medicine (HFM)-332 on the "Development and Implementation of Autonomous Transport Medical Systems for Casualty Evacuation." As a member of the RTG, Mr. Fisher presented TATRC's related research efforts on Autonomous Care and Evacuation. This RTG is chaired by Dr. Jose Salinas, U.S. Army Institute of Surgical Research, and mentored by the esteemed Dr. Terry Rauch, with participation from partnering allied nations that include the Netherlands, Germany, Czech Republic, Italy, Canada, and Sweden. This specific RTG is a three-year effort that is slated to end in April 2024.

This newly established NATO RTG will develop methods to leverage autonomous and unmanned systems in future conflicts to support casualty evacuation, including evidence-based guidance to assist commanders in making an informed decision on its use by refining concepts of operations, standards, and mission planning capabilities to effectively coordinate tactical care and evacuation.

A conceptual illustration of a Robotic Casualty Evacuation, or "RASEVAC," on the future battlefield.

The RTG will produce a strategic plan with guidance coordinated across operational and medical communities of interest that is based on current research and technology in autonomous systems, Command, Control Computers, Communications, Cyber-defense (C5), intelligence, surveillance, and reconnaissance (ISR), robotics and automation of transportation, and medical care of casualties. Plans and guidance will include the use of autonomous vehicles for casualty transport, implementation of safe ride standards, interoperability of medical equipment, and mission planning for casualty evacuation. The RTG will also produce a strategic roadmap of future research and development requirements to incorporate into the continuum of care and expanding medical capabilities across the operational spectrum.

"These types of meetings and panels are key to solidifying our partnerships and involvement with other countries and organizations to address a critical need for future operations" said Dr. Salinas.

During the next meeting, panel members will present the work of their individual countries efforts related to this topic, and further define the scope and work plan to accomplish the overall goals of the panel.

Mr. Nathan Fisher Takes the Reins of TATRC's MedRAS Division

After serving as the Deputy Division Chief for several years, and recently as Acting Chief of the Medical Robotics and Autonomous Systems (MedRAS) Division, Mr. Fisher was officially appointed as the Chief of the Division in April 2021. Mr. Fisher started his TATRC journey over seven years ago as Research Engineer and Subject Matter Expert in robotics and mechanical engineering. Nathan's role evolved over time leading him to serve as a Principal Investigator for TATRC's intramural research projects and playing a key role in shaping the MedRAS S&T Task Area, as well as building the core competencies of the Division formerly titled the "Medical Intelligent Systems Lab," under the guidance and mentorship of the previous Division lead, Dr. Gary Gilbert.

"It truly is an honor to lead this group at TATRC," stated Mr. Fisher. "Dr. Gilbert has stressed to me that the key to the future success of this lab is building a strong team. I am continually impressed with the expertise, passion, and professionalism of each of the MedRAS team members, which gives me confidence in our ability to execute our challenging research mission."

The MedRAS Division's research mission is directly aligned with the Army S&T Task Area of the same name, focused on applying robotics and artificial intelligence (AI) technologies to rapidly bring the right expertise, tools, and supplies to the point of need to affect pre-hospital care. Areas of research include: the application of medical RAS technologies to allow local care providers to be assisted by medical robotics, either driven by conventional tele-operation from remote experts, or driven by AI or closed-loop control; and leveraging the growing use of unmanned air and ground vehicles to expedite the evacuation of casualties or the delivery of supplies to support field care when evacuation is not possible, all while minimizing risk to Soldiers.

The fundamentals of the Division include early test and evaluation of emerging technologies and concepts, involving hands-on operations from Soldiers and Medics under realistic operational conditions. The team also intends to continue to build on our well-established relationships with other military, government, academic and private organizations to leverage expertise and maximize utilization of scarce RDT&E resources in order to provide technical solutions to medical capability gaps for forces operating in challenging pre-hospital settings.

Mr. Nathan Fisher, Division Chief,
Medical Robotics and Autonomous Systems (MedRAS)

The MedRAS Division consists of a relatively small (but growing) core group of research engineers and scientists at TATRC, all specializing in robotics and its associated engineering disciplines, to include biomedical engineering. This driven group is leading several collaborative intramural research efforts involving close partnerships with other USAMRDC labs, other DoD R&D organizations, industry, and academia, as well as providing technical guidance and oversight to sponsored extramural research efforts.

"Leading this division has already proven to be highly rewarding. I'm excited to continue to work with world-class researchers and engineers on compelling technology solutions to address a problem that truly matters," stated Mr. Fisher.

TATRC is looking forward to watching our MedRAS Division grow and excel under Mr. Fisher's strong leadership.

AMTI
ADVANCED MEDICAL TECHNOLOGY INITIATIVE

PROJECT SPOTLIGHT

Gait Retraining Enhances Athletes' Technique (GREAT) Running

Military service members continue to sustain traumatic anterior cruciate ligament (ACL) injuries at a high rate in training and sports-related activities. The significant lost duty time, poor self-reported functional outcomes, and long-term disability caused by these injuries directly leads to degraded operational readiness and exorbitant costs to both the Military Health System (MHS) and the Department of Veterans Affairs. After surgical reconstruction to repair the anterior cruciate ligament (ACLR), less than half of Service Members return to full duty. Knee strength and lower extremity biomechanical asymmetries during running are commonly observed in the civilian general population following surgery and have been shown to contribute to greater self-reported disability, greater risk of knee re-injury and the progression of knee osteoarthritis. However, the presence of asymmetries in military Service Members following surgery and how they relate to symptoms, function and further joint degeneration throughout recovery are not well known.

In 2018, researchers of the Keller Army Community Hospital (KACH), Baylor University – KACH Division I Sports Physical Therapy Fellowship at West Point, New York embarked on a project titled, "Gait Retraining Enhances Athletes' Technique: (GREAT) Running," to explore whether some of the key factors that affect civilians' rehabilitation and functional outcomes following ACLR also affect our Service Members. In addition, the team sought to assess a wireless wearable in-shoe biofeedback sensor (Loadsol®) to detect landing biomechanics in Service Members and assess the relationships among the landing patterns and hop performance, levels of biomarkers representative of chondral injury, patient reported outcome measures, running biomechanics, and knee strength following ACLR. The final deliverables of the project will speak to the 'Quality, Readiness and Reduced Cost' pillars of the Advanced Medical Technology Initiative (AMTI) Program.

So far, the team has observed significant lower extremity asymmetries in measures of knee strength (quadriceps peak torque) and running biomechanics (peak knee flexion angle, knee flexion angle at initial contact, heel-to-center of mass distance at initial contact, peak internal knee extensor moment, peak vertical ground reaction force and braking impulse) when Service Members were cleared to return to running activities (approximately 5 months post-surgery). The team's novel preliminary results suggest that there is a large-magnitude of unresolved knee strength deficit and lower extremity running biomechanical asymmetries post-ACLR in military Service Members. This is concerning, considering reduced strength, and asymmetrical movement patterns following ACLR may contribute to development of knee osteoarthritis and increased risk for re-injury. From a clinical perspective, these data indicate that military Service Members are being cleared to return to run when their surgical limb physical impairments indicate that they may not be strong enough or move safe enough to do so. Military clinicians may need additional guidelines focused on restoring quadriceps strength limb symmetry before initiating return to running to mitigate potentially harmful running biomechanics asymmetry and subsequent knee damage in Service Members after ACLR.

The preliminary results of this AMTI project were accepted for platform presentations at both the 2021 American

***GREAT Running** continued to page 23*

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Physical Therapy Association Combined Sections Meeting and the 2020 Military Health System Research Symposium (MHSRS). Additionally, the project was one of 12 out of 258 abstracts accepted for an oral presentation in the Young Investigator Breakout Session, and subsequently on the short list for the MHSRS 2020 Young Investigator's Award.

Results from additional project deliverables, to include the efficacy of the Loadsol® are forthcoming. The Loadsol® is an in-shoe insole system that enables measurement of force between the foot and the shoe during dynamic movements. Traditionally, force has needed to be measured in a research laboratory, however, Loadsol® technology offers military clinicians the ability to measure important movement biomechanics right in any MHS physical therapy clinic. The system is user friendly and has options to provide real-time auditory, visual or vibratory feedback to patients on relevant biomechanical parameters such as peak force, step rate, average vertical loading rate, contact time and symmetry.

Information from the preliminary analysis of Loadsol® will be used to plan future efforts assessing the wearable insole technology's usefulness to assess symmetry of movement patterns in Service Members after ACLR. The team is also currently processing results to better understand the relationships among levels of biomarkers representative of chondral injury (osteoarthritis markers) with patient reported outcome measures, running biomechanics, and knee strength following ACLR. Results from the remaining deliverables will be submitted for presentation at the MHSRS Conference in 2022 and submitted for peer-reviewed publication.

Figure 1: A military Service Member completing a three-dimensional biomechanics evaluation to assess lower extremity asymmetries following Anterior Cruciate Ligament reconstruction (A), and an example of the resulting three-dimensional model (B).

Despite pandemic-related delays and roadblocks, this novel AMTI demonstration project represents the first to provide insight into military Service Members' knee strength and running biomechanics after ACL injury. The knowledge that strength and movement deficits not only exist, but that some exist at a greater magnitude in our Service Members than in civilians following surgery, and what other clinical factors they are related to, is important. This information can help military clinicians re-assess their clinical outcomes and benchmarks and enhance therapeutic interventions. In civilian populations, these movement patterns and strength deficits do not resolve long term and may contribute to return to duty limitations in Service Members. Since both knee strength and running biomechanics are modifiable factors, the team's future work will seek to examine the effect of strength and gait retraining interventions using the Loadsol® technology to improve these important outcomes in a military population.

The significance of this project on the MHS is indisputable. Effective evidence-based and clinically feasible rehabilitation screening and intervention tools targeting post-injury physical outcomes are essential for reducing the adverse impacts of ACL injuries to both the individual Warfighter and the MHS. The preliminary results of this project represent the first step towards identifying knee strength and running biomechanical factors of which we can focus therapeutic interventions to improve return to preinjury levels of activity in this population, as well as long term joint health. This data is essential to improving our military's lives and welfare, who sustain an ACL injury and undergo ACLR while in service to their country.

The Lead Project Innovator, MAJ

GREAT Running
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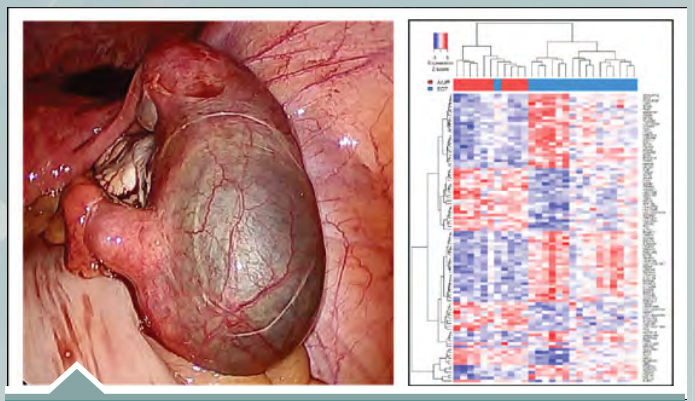
AMTI
ADVANCED MEDICAL TECHNOLOGY INITIATIVE

PROJECT SPOTLIGHT

A Genomic Classifier for the Early Detection of Ectopic Pregnancy

Did you know that nearly 16% of active component U.S. military members are women, and the majority are reproductive age? As the number of military servicewomen and their operational scope increase, it is important to understand and mitigate health issues that uniquely impact female servicemember readiness. Ectopic pregnancy accounts for 1-2% of all pregnancies in the United States and remains the leading cause of maternal death in the first trimester. An ectopic pregnancy can present with bleeding and/or pelvic pain. A serologically confirmed pregnancy that is clinically determined to be non-viable but cannot be reliably delineated as intrauterine or ectopic by ultrasound is defined as a non-viable pregnancy of unknown location (NV-PUL). Nearly 20% of women with a NV-PUL are ultimately found to have an ectopic pregnancy. In the absence of a biomarker to discern pregnancy location, patients are carefully followed with serial exams and labs to definitively resolve NV-PULs, and approximately half of patients require more than three clinic visits over a seven-day interval. This process risks loss to follow-up and delay in treatment in ectopic cases, which can result in tubal rupture and associated morbidity and mortality.

The absence of a reliable method for the early detection of ectopic pregnancy has important readiness implications for military servicewomen. Not only does the current PUL management algorithm translate to lost time from work/training, but the psychological stress associated with the uncertainty during this interval may negatively impact performance. Early detection of ectopic pregnancy allows intervention at a time when medical management has a better chance of success, thereby obviating the need for surgery, surgical risks and more lengthy recovery timeframes. A biomarker or classifier is a molecular analyte or panel of analytes used to diagnose a particular disease condition. Actuarial studies reveal that a biomarker for ectopic pregnancy would save approximately $1880 in healthcare costs per patient. By reducing the number of visits required to diagnose pregnancy location, a classifier improves overall access to care. Most importantly, a classifier that allows the early detection of ectopic pregnancy reduces the likelihood of tubal rupture associated with diagnostic delay, thereby improving patient safety and military readiness.



Left: If not diagnosed early, a tubal (ectopic) pregnancy can rupture, resulting in hemorrhage-associated morbidity and mortality. Right: Gene expression profiling of intrauterine samples from women with ectopic compared with that of women with miscarriage (AIUP) revealed a 5-gene classifier that reliably delineates pregnancy location.

The past decade has witnessed remarkable advances in high throughput molecular techniques and bioinformatics approaches culminating in more personalized diagnostics and treatments. At Madigan Army Medical Center, Precision Medicine Research is facilitated by the Department of

***Ectopic Pregnancy* continued to page 25**

Ectopic Pregnancy continued from page 24

Clinical Investigation's (DCI) core laboratory that includes biobank, proteogenomic and bioinformatics services. A team from the Department of Obstetrics and Gynecology led by Principal Investigator, Dr. (COL retired) Greg Chow, hypothesized that detectable molecular differences exist in intrauterine samples from women with ectopic pregnancy compared to women with miscarriage, and the most reliably detected differences could be included in a molecular classifier to delineate pregnancy location.

In an IRB-approved global gene expression study involving samples from 65 women with ectopic pregnancy or miscarriage, an intrauterine genomic classifier was developed by the Madigan team. The five most reliably differentially expressed genes were combined to formulate a classifier for pregnancy location. In this AMTI-funded demonstration, the classifier was independently tested and found to be 91% (42/46) accurate in delineating pregnancy location as intrauterine or ectopic. Importantly, the classifier was translated to an n-counter (Nanostring) detection strategy to abbreviate turn-around-time to less than 24 hours. The technology was filed for full utility patent in March 2019. Co-inventor and Madigan Reproductive Endocrinology and Infertility (REI) Fellow, MAJ Jessica Lentscher, presented the results at the 2019 meeting of the Society for Reproductive Investigation, winning the Best Investigator Award. Findings were published as a peer-reviewed manuscript in Fertility and Sterility, a leading journal in Women's Health.

"Funding from the AMTI program made this go – this is a great example of military GME partnering with DCI to address a military-relevant gap with patented innovation," said Dr. (COL retired) Rick Burney, Chief of DCI and a co-investigator/co-inventor. "Given the cost and scale, the refinement and demonstration of this molecular classifier would not have been possible without AMTI investment." To build on these successes, the team plans to analyze proteogenomic signatures of surgically removed tubal pregnancies toward identifying other potential biomarker/classifier candidates.

For additional information on this AMTI funded project, please contact Ms. Holly Pavliscsak at holly.h.pavliscsak.ctr@mail.mil.

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Figure 2: Loadsol® Insole with iPhone and Shoe

Bryan Pickens, summed up this effort stating, "This project and the knowledge we have obtained is critical in advancing the post-operative management of individuals with ACL injury. Targeting the asymmetries observed in this study may serve to improve return to duty rates and mission readiness in military service members. This critically important work would not be possible without the support of TATRC's AMTI Program. The AMTI Program has been pivotal in the execution of this novel demonstration project. Without AMTI's funding, strategic mentorship and unwavering support the project would not have been possible. With AMTI's continued guidance we hope to expand the results of this project to improve the clinical resources available to military providers for improved decision making and in-clinic detection of potentially injurious strength and movement asymmetries following ACLR that may contribute to poor full return to duty rates."

For additional information on this AMTI funded project, please contact Ms. Holly Pavliscsak at holly.h.pavliscsak.ctr@mail.mil.

AMTI
ADVANCED MEDICAL TECHNOLOGY INITIATIVE

PROJECT SPOTLIGHT

Promoting healthier food purchases among military Service Members at Fort Bragg

A majority of military Service Members are overweight or obese and are not meeting physical fitness goals, leading to increased health care costs and days of lost work per year. This is a potential national security threat as obesity and poor dietary choices have been associated with increased risk for musculoskeletal injuries and chronic illness and lack of physical readiness. Thus, new strategies are needed to optimize Warfighter performance.

One approach that military services have taken to address the obesity and readiness issue is to change the foods that Soldiers are purchasing through modifications of their food environment. An emerging technology that has potential to change how Soldiers interact with a food environment is 'geofencing.' This technology uses cellular networks and beacon-based Bluetooth signals to create a virtual perimeter that sends real-time targeted messages or "nudges" to those with mobile devices that enter a designed space, such as within immediate proximity of a dining facility, or DFAC. With Service Members increasingly using their mobile phones, this may be a viable approach to improve the utilization of healthier dining options on military bases and improve food purchases. To further explore this, an Advanced Medical Technology Initiative (AMTI) funded project out of Womack Army Medical Center, completed an in-depth formative evaluation of a healthy eating place-based technology pilot study at Fort Bragg to better understand the feasibility of this type of health promotion program in this setting.

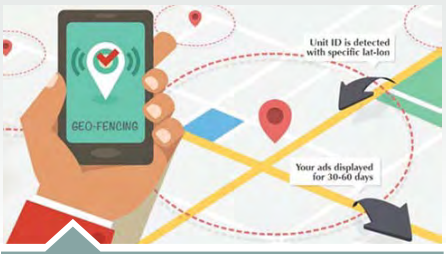

Figure 1. Geofence Illustration

The project tasks of this pilot study were successfully completed and largely included the development and testing of a multi-layered interactive food environment system that incorporated both geofencing and utilization of Bluetooth Beacons at a Fort Bragg dining facility, Womack Army Medical Center's Blue Ribbon Bistro. The Womack team collaborated with key Fort Bragg stakeholders, topic experts, and Propellant Media to develop geotargeted advertisements, a dedicated webpage "goeatwellnow.com", and a dedicated mobile phone application called "Eat Well Now" that served as the interaction hub between the user, the beacons and the dedicated webpage. The research team was able to successfully deploy the beacons and associated app within the Blue Ribbon Bistro and make them operational. They also created a

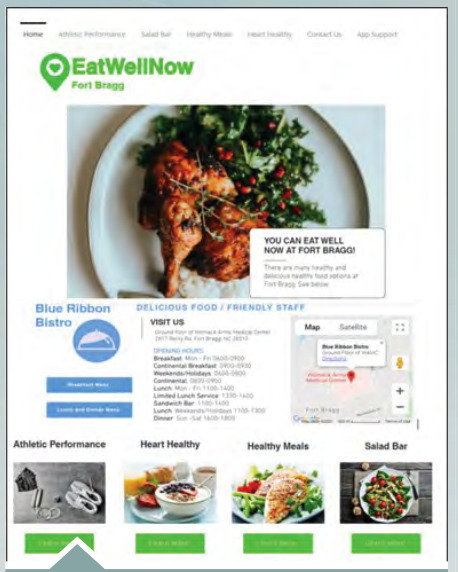

Figure 2. Sample of "goeatwellnow.com". Includes information about the Blue Ribbon Bistro and how to eat for 'Athletic Performance', 'Heart Healthy', 'Healthy Meals', and 'Salad Bar'.

Healthier food purchases

continued to page 27

Healthier food purchases *continued from page 26*

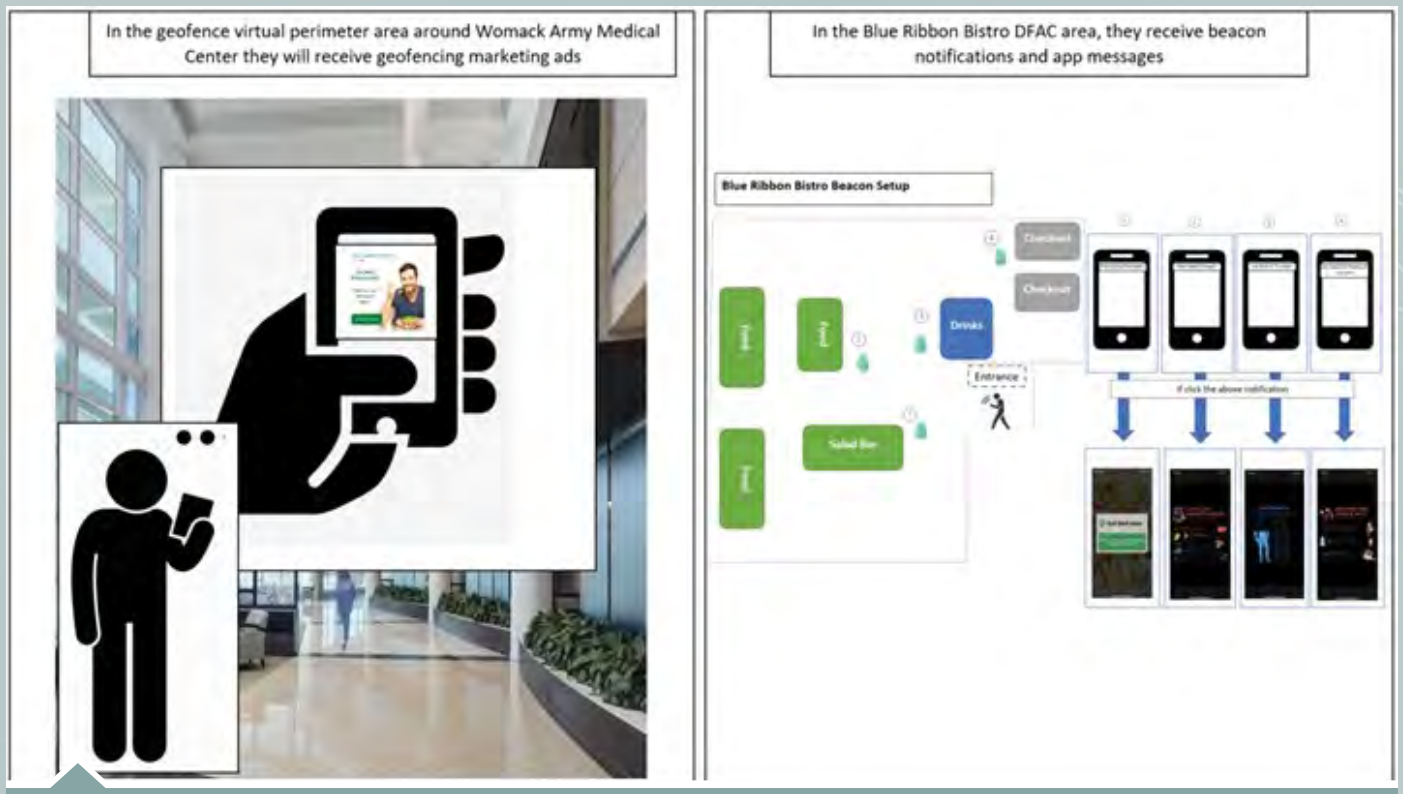

Figure 3. WAMC Blue Ribbon Bistro Beacon Setup

connected data server which allowed them to understand interaction with the beacons and therefore allowed the Fort Bragg Department of Public Health and the Blue Ribbon Bistro staff to understand the effectiveness of different messaging approaches. "The goal is to 'nudge' users towards healthier decisions at each of these decision points, with simple messaging and graphics. We want to meet Soldiers where they are within their activities of daily life," stated one of the Project Leads, Dr. Jared McGuirt.

This effort aligns with the AMTI Program's FY20 areas of focus which are: 1) medical readiness of the total Army, and 2) Healthy & Satisfied Families and Beneficiaries. The Womack team successfully leveraged enterprise level solutions to align with the strategic plan of improving troop readiness and access to healthier food. This connects Service Members to health initiatives being promoted at military base public health centers and aligns with the Healthy Base Initiative.

The work this team has accomplished demonstrates that there is a clear opportunity to further build a scalable and impactful digital healthy eating food environment to encourage Soldiers to eat healthier and improve readiness. The research team believes there are many opportunities to further develop the interactive experience, including enhancing the app interface to allow for more tailored content based on the Soldier's goals, and integrating the geofencing and Bluetooth analytics to create a very cohesive food environment experience. The hope is to listen and work with Soldiers and military service leaders in the future to further develop the system to optimize relatability, usability and impact.

The next step after this initial project would be a larger formal evaluation study examining the impact of the intervention on food purchases, dietary behaviors, and health outcomes among military Service Members interacting with the intervention. This is the clear next step to determine the potential of this innovation and the Womack researchers hope to continue to work with additional dining facilities at Fort Bragg and beyond to test and implement the system.

CPT Danielle Dunnagan, the Lead AMTI Innovator for this project stated, "The technology we are exploring in this pilot study has the potential to greatly impact the way we promote healthful food choices within the military food environment. As a Registered Dietitian, I am eager to use this technology in the future to help make the healthier dietary choice the easier one for military Service Members, especially within the footprint that they live and work."

For additional information on this AMTI funded project, please contact Ms. Holly Pavliscsak at holly.h.pavliscsak.ctr@mail.mil.

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