



Team TATRC Goes Virtual Amidst Quarantine



TATRC's first-ever Virtual Town Hall held amidst the quarantine.

Not even COVID-19 could slow us down here at Team TATRC! In the wake of the Coronavirus, the entire organization went remote and “virtual” on 17 March, and completely shifted to telework due to statewide “stay-at-home” orders and social distancing guidelines. Understandably, these conditions have added some complexity to work life, not the least of which includes the quarterly Town Hall meetings held by Director COL Jeremy Pamplin. However, utilizing technology for virtual communications is no stranger to the Telemedicine and Advanced Technology Research Center! So, COL Pamplin set about creating and distributing the organization’s first-ever Virtual Town Hall! Using a solution as simple as PowerPoint, an audio recording and an email, COL Pamplin was able to get the message out to the team when it perhaps needed it the most.

A major component of the Virtual Town Hall was distribution of critical information regarding the current state of the outbreak of the virus, as well as important steps for staying aware, protected, and proactive for personal health and safety. Through various slides and imagery, the topics ranged from the history of the virus and others like it, infection prevention information, explanation of social distancing guidelines, and the state of the outbreak nation-wide, as well as the military’s role and specifically, some of the initiatives TATRC is working on in response to COVID 19.

This part of the message set the stage for COL Pamplin’s next point, which was one of ‘Stay the Course.’ He stressed that the efforts TATRC has been making for years has uniquely positioned us to “lead the technology response to the disaster through our work in Digital Health and Telemedicine, our knowledge of Information Technologies and

Going Virtual continued to page 2

IN THIS ISSUE:

TEAM TATRC GOES VIRTUAL AMIDST QUARANTINE	1
TATRC WELCOMES THE ARRIVAL OF NEW SCIENCE DIRECTOR	2
TATRC DEPUTY GETS PICKED UP FOR PROMOTION TO O6!	3
BIG NEWS ON THE HORIZON FOR TEAM TATRC!	3
BHSAI DIRECTOR ‘HEATS’ THINGS UP IN QUEBEC AT THE 5TH INTERNATIONAL CONGRESS ON SOLDIERS’ PHYSICAL PERFORMANCE (ICSP)	4
MISL LAB INTRODUCES NEW “COMBAT EVACUATION MISSION MODULE” PROJECT	5
TEAM TATRC PARTICIPATES AT RECORD BREAKING IMSH CONFERENCE!	6
TATRC BLASTS OFF ON A “LAUNCH DATE” WITH NASA	8
TATRC RESEARCH SUPPORTS US NAVY BUREAU OF MEDICINE AND SURGERY	10
TATRC’S MHIC OFFICE RECOGNIZES MR. NATE MONTGOMERY AS Q 2 EMPLOYEE OF THE QUARTER	11
EMPLOYEE SPOTLIGHT: TATRC CONGRATULATES Q - 2 EMPLOYEE OF THE QUARTER, MR. ROB CHEWNING!	12
EMPLOYEE SPOTLIGHT: TATRC WELCOMES NEW ARTIFICIAL INTELLIGENCE & MACHINE LEARNING ENGINEER	13
EMPLOYEE SPOTLIGHT: TATRC ADDS A ROBOTICS ENGINEER TO THE MISL TEAM	14
EMPLOYEE SPOTLIGHT: TATRC WELCOMES A NEW PROJECT OFFICER TO THE TEAM! ..	14
AMTI PROJECT SPOTLIGHT: USE OF THE RAPTOR SYSTEM IN OUTPATIENT PHYSICAL THERAPY: A MULTI-SITE DEMONSTRATION PROJECT	15
AMTI PROJECT SPOTLIGHT: RAPID QUALITATIVE ANTIBIOTIC RESISTANCE CHARACTERIZATION USING VITEK MS	17

TATRC Welcomes the Arrival of NEW Science Director

Please join us in extending a very warm welcome to our newest addition to join TATRC's Command and Leadership Team. Mr. Matt Quinn joins the Team as TATRC's third Science Director! Mr. Quinn officially began his tenure with us in early March, and we are thrilled to have him on board!

Matt brings federal, private sector and military experience to TATRC. Most recently, he served as Senior Advisor for Health Technology for the Health Resources & Services Administration (HRSA), the primary federal agency in the U.S. Department of Health and Human Services for improving health care to people who are geographically isolated, economically or medically vulnerable. While at HRSA, Matt was recognized with the FedHealthIT100 award for driving change and advancement in the Federal Health IT ecosystem and received the HHS Distinguished Service Award, the highest honor granted by the department.

Mr. Quinn was previously Managing Director of Intel's Healthcare and Life Sciences business on the East Coast, Director of Healthcare Initiatives for the Federal Communications Commission (FCC), authored key NIST guidance on improving health IT usability and as a Senior Fellow at the Agency for Healthcare Research & Quality, worked to realize the value of health technology in emerging models of care delivery. While at Intel and FCC, Matt testified before both the House

and Senate on advancing telehealth and other health technologies.

Before joining government, Mr. Quinn was the Healthcare Industry Manager for Teradata, responsible for healthcare strategy and partnerships for the "big data" analytics company, led GE Healthcare's "Six Sigma for Healthcare" consulting services and data analytic products, helped build an early health analytics company, and served as an Army Engineer Officer. Matt earned an engineering degree from the United States Military Academy at West Point and an MBA from Colorado State University.

Since joining TATRC, Matt has been deeply involved in our cross-lab efforts to combat the COVID pandemic through the National Emergency Tele-Critical Care Network (NETCCN) project and the Technology in Disaster Environments (TiDE) projects that will follow. Because these projects, like the pandemic, involve both the U.S. healthcare system and military medicine, Mr. Quinn's deep relationships throughout the Department of Health and Human Services and other agencies have been helpful in garnering support and integration of TATRC's efforts into broader initiatives.

While the COVID work has been primary, Matt is looking forward to focusing on non-COVID projects and expanding the scientific productivity of TATRC. As the organization moves to becoming its own command and shifts to support more intramural research, he seeks to establish the systems and processes to support TATRC



Mr. Matt Quinn, TATRC's newest Science Director.

staff in serving as Principal Investigators for projects, publishing in peer-reviewed journals and establish measures and metrics to measure the "science" of TATRC. In addition, Matt plans to focus on fostering collaboration among TATRC labs, fellow MRDC labs, and partnering with other government agencies.

Matt lives in Poolesville, MD, is married to Patricia and has three kids: Siena, who is 15 and a rising sophomore at Poolesville High School and twin 10-year-old boys named Hunter and Taylor. He enjoys aquariums, hiking and fishing and is looking forward to the end of the pandemic to begin traveling again.

With our Leadership team now complete, we're firing on all cylinders and readier than ever to tackle the important work that lies ahead for TATRC. ■■■

Going Virtual

continued from page 1

how to adapt them to austere medical environments, our efforts to automate critical systems, and ultimately our vision to bring them together into one intelligent medical system."

It was also important to note that the work TATRC would do to accelerate technologies during COVID-19 is the same work we had been doing for years to help support the Warfighter. Avoiding

injury and illness, optimizing casualty care – all important, necessary work to be successful in the fight against our newest viral foe.

Throughout our time of working remotely, sincere, dedicated efforts have been made organization-wide to ensure the continuation and progression of TATRC's mission. Whether its being relegated to video conferences for meetings, navigating VPN access, or simply not being able to catch up with coworkers over coffee – the hurdles have certainly been real, but as

a Team we have jumped them all and continued pushing on. Thus, now, perhaps more than ever, reassurance from our Leadership that the work we are doing is important and the strength of our Team is unbreakable is so valuable.

As COL Pamplin said in closing, "We are TEAM TATRC!" Thank you to every member of the Team for your dedication, patience and efforts, and we look forward to seeing everyone around the office again soon! ■■■

TATRC Deputy Gets Picked up for Promotion to O6!

Congratulations are in order as our dutiful and dedicated Deputy Director, LTC Justin Stewart, has been selected for COLONEL and is now LTC (P) Stewart! A board-certified, Internal Medicine Physician who completed his residency at Brooke Army Medical Center, and whose education includes a DO from the UNT Health Science Center--Texas College of Osteopathic Medicine and a MBA and MHA from Baylor University, LTC (P) Stewart has served overseas in Korea, Iraq and Afghanistan, as well as having served as Command Surgeon

of the 593rd Sustainment Command (Expeditionary) prior to joining us here at TATRC. Since his arrival to TATRC last August, he has been a key figure in the reorganization efforts and is a perfect fit! The Team is incredibly proud of LTC (P) Stewart for attaining this exclusive achievement. So exclusive in fact, that less than 3% of officers earn the honor of the O6 rank! Congratulations on this well-deserved achievement, Sir! The eagles are going to look good on you! **///**



LTC(P) Justin Stewart, DO, MBA, MHA (Deputy Director)

Big News on the Horizon for Team TATRC!



Big news is on the horizon here at TATRC! The Team has been hard at work refocusing and creating a new path forward for TATRC that will better align itself to the recent restructuring that has happened across the entire DoD. With our organization now falling under the Army Futures Command, we wanted to adapt and reengineer our mission and the vision that TATRC will have for the future. These new strategic messaging efforts include

developing a fresh, new website with several new resources, updated media content, as well as restructuring of the organizations' labs and programs that make up TATRC as a whole in order to have a cohesive and uniform effort in support of our Mission. A lot is happening and we can't wait to share it with you! Be sure to stay tuned as this story develops and unfolds later this Summer! **///**

Let's Get Social!



For more information on TATRC and its many initiatives, visit: www.tatrc.org or call 301.619.7927

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BHSAI Director ‘Heats’ Things Up in Quebec at the 5th International Congress on Soldiers’ Physical Performance (ICSPP)



At the 5th International Congress on Soldiers’ Physical Performance (ICSPP), which was held in mid February, at the Fairmont Le Château Frontenac in Quebec City, Dr. Jaques Reifman, Director of TATRC’s Biotechnology High Performance Computing Software Applications Institute (BHSAI), delivered three highly regarded presentations on heat stress, Warfighter alertness and core body temperature estimation to a crowd of over 500 participants focused on optimizing the physical performance of the men and women serving our respective countries.

The ICSPP is the most important international congress in applied military human performance research and attracts experts from all over the world. The congress covers a broad range of disciplines including physical training programs and adaptations, occupational and physical performance, testing and assessment, injury prevention, public health and health promotion, nutritional considerations, human factors, ergonomics, equipment design, biomechanics, load carriage, gender integration issues, thermoregulation and environmental issues, deployment considerations, and psychological and cognitive factors.

Dr. Reifman’s first presentation was entitled, “A 3-D Virtual Human Thermoregulatory Model to Predict Heat-Stress Responses.” He highlighted that BHSAI scientists demonstrated the ability of the model to estimate increases in organ-specific temperatures, which often exceeded the core body temperature, when subjects were exposed to environmental and exertional stressors (data provided by the University of Connecticut). The model will afford the ability to link increases in organ temperature with decreases in physical and cognitive performance, providing a unique opportunity to readily compare and contrast dozens of existing and future cooling strategies for the human body, which cannot be evaluated experimentally.

The second presentation focused on “Individualized Interventions to Optimize and Enhance Warfighter Alertness.” Using a recently developed caffeine optimization tool, BHSAI researchers showed that for a group of subjects, the tool provided recommendations that were safer and more efficient than those provided by the group-average recommendations, both for subjects highly vulnerable and those least vulnerable to sleep deprivation (data provided by the Walter Reed Army Institute of Research). This unique tool will help to mitigate the risk of Warfighters with impaired alertness making mistakes, by providing optimal caffeine recommendations that consider the individual’s response to sleep loss.

Dr. Reifman’s presentations concluded with the third and final address entitled, “An AI System for Real-Time Individualized Core Body Temperature Estimation.” This presentation highlighted BHSAI scientists who developed an AI algorithm that provides accurate, real-time, individualized estimates of core body temperature that serve as reliable surrogates for invasive measurements usually obtained by rectal probes (the conventional gold standard method). They showed that the algorithm performed well even when the same subject was exposed to different environmental conditions, and when it was provided with non-invasive measurements involving missing or unreliable data (data provided by multiple institutes in Israel and New Zealand). As heat-related injuries pose a threat to the health and operational effectiveness of Warfighters in hot and humid environments, the algorithm, which is already integrated into a hardware/software system, will help reduce the risk of heat injuries during training and military operations.

The ICSPP Conference is held every three years and the next event will be held in the United Kingdom in 2023. ■■■

MISL Lab Introduces New “Combat Evacuation Mission Module” Project

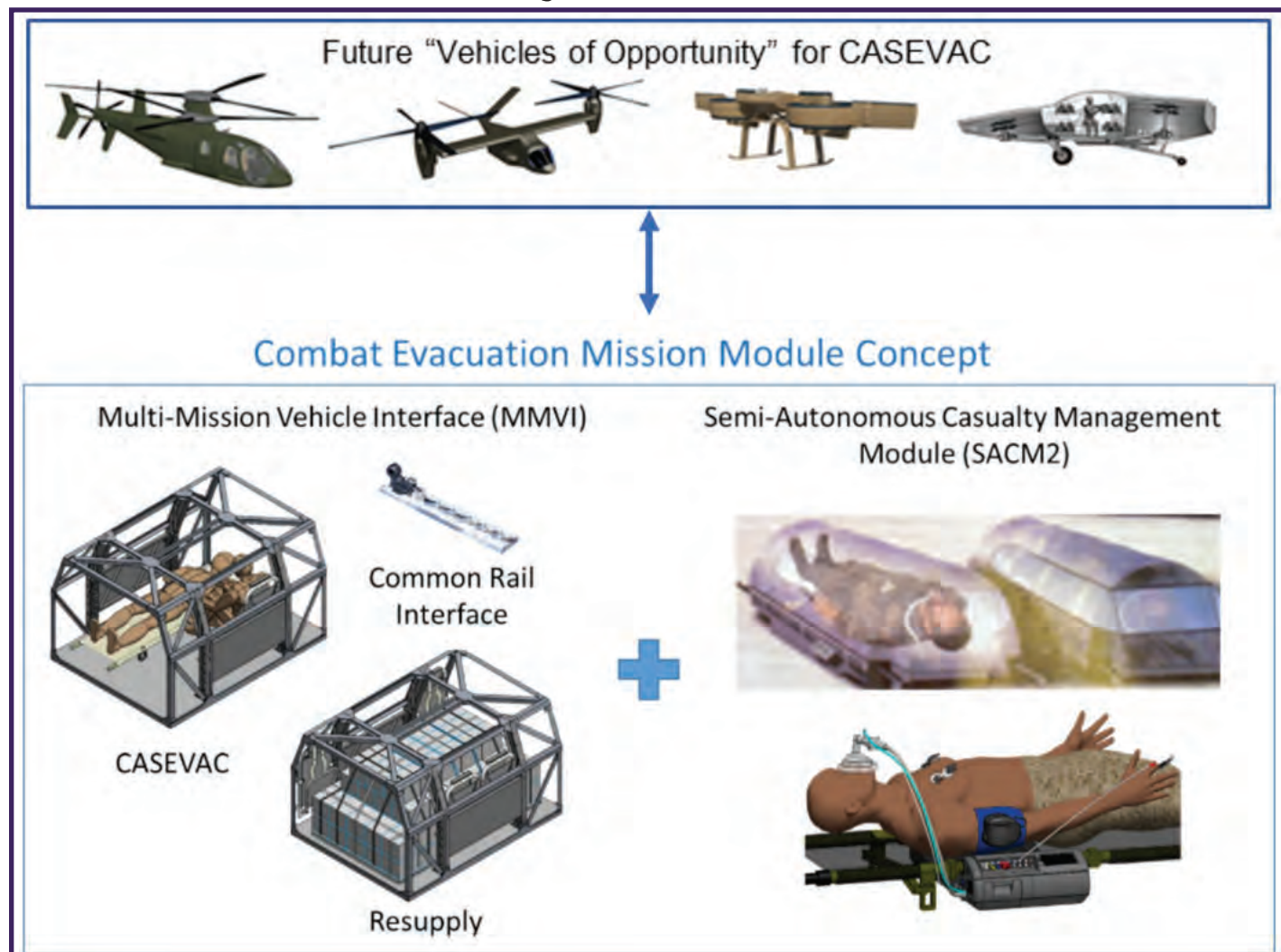


Figure 1: Illustration of CEMM Concept

TATRC's Medical Intelligent Systems Lab (MISL) has joined forces with the U.S. Army Aeromedical Research Laboratory (USAARL) and Naval Air System Command (NAVAIR) on a new Science and Technology (S&T) effort entitled, “Combat Evacuation Mission Module” (CEMM), a Medical Robotic and Autonomous Systems (MedRAS) S&T Task Area project.

The CEMM project aims to explore methods of increasing casualty evacuation capability and capacity during Multi-Domain Operations by utilizing non-traditional evacuation platforms to expedite transport of combat casualties while still providing required en route care in high-risk or

resource constrained environments. This concept includes future use-cases involving both “autonomous transport” onboard unmanned or optionally-piloted vehicles, and “autonomous treatment” through a remotely monitored and controlled treatment and patient management system. The project has both PE6.2 Applied Research aims focused on autonomous treatment en route, and PE6.3 Advanced Technology aims focused on autonomous transport.

The CEMM PE6.2 aims focus on providing the necessary patient- and medic-facing systems for effective remotely operated and / or semi-autonomous en route care systems. Initial research focuses

on evaluating emerging en route care technologies derived from extramural and intramural research supporting the MedRAS and Virtual Health Task Areas. Additionally, approaches for providing a communication infrastructure and cyber security solutions for remote patient monitoring, and remote supervision and control of semi-autonomous patient management systems will also be investigated.

The focus of the CEMM PE6.3 effort is twofold. The first aim is to design

CEMM Concept

continued to page 7

Team TATRC Participates at Record Breaking IMSH Conference!



TATRC was well represented by our Director, COL Jeremy Pamplin, Medical Modeling Simulation Informatics and Visualization (MMSIV) Lab Lead and senior research scientist, Mr. Geoff Miller, Ms. Lori DeBernardis, the Director of TATRC's Marketing & PAO, and MMSIV's Project Officer, Mr. Jimmy Gaudaen, all actively engaged.

TATRC was once again honored to attend and take part in one of our favorite simulation events of the entire calendar year! The 2020 International Meeting for Simulation in Healthcare (IMSH) took place 18-22 January, in sunny San Diego, CA and was another record breaking year for IMSH with over 4,100 attendees taking part in this unique event. As the world's largest conference dedicated to healthcare simulation learning and research, this major event is always a keystone for TATRC. The theme of this year's conference was, "Inspired by our Patients - Driven by the Future!" and it did not disappoint. TATRC was well represented by our Director, COL Jeremy Pamplin, Medical Modeling Simulation Informatics and Visualization (MMSIV) Lab Lead and senior research scientist, Mr. Geoff Miller, Ms. Lori DeBernardis, the Director of TATRC's Marketing & PAO, and MMSIV's Project Officer, Mr. Jimmy Gaudaen, all actively engaged.

This year, TATRC was proud to exhibit at a booth inside IMSH's Government Row where we were able to directly interface with industry leaders and our federal partners, and have meaningful one-on-one dialogue with conference participants. The Exhibit Hall boasted 950 exhibitors and

featured all different kinds of simulators, manikins, and virtual reality trainers for attendees to interact with. Among these innovative technologies was CPT Kyle Couperus, who showcased his impressive Augmented Reality / Virtual Reality project, and is one of TATRC's Advanced Medical Technology Initiative funded innovators. CPT Kyle Couperus had previously been recognized at IMSH 2019, where he received the prestigious 'SimVentor' Award out of 82 other projects.

One of the highlights of the 2020 conference for the TATRC Team was when our very own MMSIV Lab Lead and resident "Super Sim Man," Mr. Geoff Miller, was awarded the Presidential Citation by Ms. KT Waxman, President of the Society for Simulation in Healthcare. This award was given in recognition of Mr. Miller's exceptional service to the society and to the global community of healthcare simulation practice.

"We were pleased to participate in this year's event as now, more than ever, simulation in healthcare is at the forefront of helping advance skills, impact change in delivery systems and practices, and improving patient safety," said COL Jeremy Pamplin.

IMSH 2020 continued to page 7

IMSH 2020 *continued from page 6*



Mr. Geoff Miller (right), was awarded the Presidential Citation by Ms. KT Waxman (left), President of the Society for Simulation in Healthcare. Photo by Edwards Rieker for IMSH.



CPT Kyle Couperus (center), showcased his impressive Augmented Reality / Virtual Reality project, and is one of TATRC's Advanced Medical Technology Initiative funded innovators.

Geoff Miller stated, "We're grateful for the opportunities this event provides to network, brainstorm, and share ideas with colleagues, both old and new. IMSH is the only conference where we can experience firsthand the work of those around us helping to advance the industry." Thanks to everyone who stopped by our booth this year, and here's to the year ahead where the team will take to New Orleans from 9 - 13 January for the 2021 IMSH Conference! ■■■

CEMM Concept *continued from page 5*

a "Multi Mission Vehicle Interface" (MMVI) that provides a common vehicle interface for medical systems and other mission packages for future transport vehicles, including designs for physical (mounting), electrical (power), and digital (data) interfaces. This system includes a Patient Handling System (PHS) that will be designed for low space and weight applications while providing versatility and re-configurability via a standard rail mounting system, as well as innovative ways of improving patient access to care providers during transport. The second aim, called the Safe Transport and Evacuation Protocol System (STEPS), focuses on communicating with mission planning and control systems for emerging unmanned or "optionally-piloted" aircraft to ensure safe patient transport onboard future autonomous vehicles by providing patient-based flight constraints to advise evacuation missions. A Technology Transition Agreement between the CEMM S&T collaborators and PM Future Long Range Assault Aircraft (FLRAA) was signed in October 2019 for these two PE6.3 aims.

Since the start of the project in October 2019, there have been two major, significant milestones. The first milestone was the official CEMM kickoff meeting held in October 2019 at the NAVAIR Cargo and Special Operations Group office located at Patuxent River, MD. This kickoff meeting offered an opportunity for S&T collaborators from TATRC, USAARL, and NAVAIR to actively engage with stakeholders from PM FLRAA, Product Office Medical Evacuation, Medical Evacuation Concepts and Capabilities Division (MECCD), and Joint Program Committee - 1 (JPC-1). One significant output of this meeting was to emphasize the importance of early interim deliverables required to inform the FLRAA program and aligned with the FLRAA development timeline.

The second significant project milestone was the successful completion of the requirements review for the MMVI and PHS subsystems, completed in May 2020. NAVAIR led this effort, and completed the review through engaging with collaborators and stakeholders during three separate virtual review sessions. During these long and extensive review sessions, the project team went through the system requirements document line by line and received valuable feedback from engineers and SMEs at NAVAIR, TATRC, USAARL, MECCD, and PM FLRAA. This feedback is critical to accurately defining the system requirements, which will guide the subsequent research and prototyping effort and shape the first major project deliverable to PM FLRAA slated for Q4 2020.

The completion of these initial milestones have set the CEMM project team on the right course for this multi-year collaborative research effort. "Our new project has benefited greatly from the high level of engagement that we've had with our stakeholders, especially MECCD and PM FLRAA, from the beginning. These stakeholders have been extremely generous in offering their subject-matter expertise and leadership to help guide us on this ambitious project. It is because of their support, and the wide-ranging competencies of our S&T collaborators, that I am optimistic that this project can have a significant impact on future casualty evacuation missions," stated Mr. Nathan Fisher, TATRC Research Project Manager and CEMM Co-Principal Investigator. ■■■

TATRC Blasts Off on a “Launch Date” with NASA

Over the last 12 months, TATRC has been working closely with the Human Research Performance (HRP) team at the National Aeronautics and Space Administration (NASA), to explore ways in which our common goals to expand digital health capabilities for asynchronous prolonged field care can be achieved together through a research partnership.

NASA's HRP Program is dedicated to discovering the best methods and technologies to support safe, productive human space travel. HRP enables space exploration by reducing the risks to astronaut health and performance using ground research facilities, the International Space Station and analog environments. This leads to the development and delivery of an exploration biomedical program focused on: informing human health, performance, and habitability standards; developing countermeasures and risk mitigation solutions; and advancing habitability and medical support technologies. HRP supports innovative, scientific human research by funding more than 300 research grants to respected universities, hospitals and NASA centers to over 200 researchers in more than 30 states.

A distinct parallel can be drawn between NASA's HRP goals and the work that TATRC is setting out to accomplish in austere environments. TATRC's Mobile Health Innovation Center (mHIC) Lab Lead, Ms. Jeanette Little stated, “The challenges that we face in the future fight, with disrupted and intermittent communication, and prolonged care align with the concerns that NASA has for deep space exploration. While the rest of the health care sector looks for digital health solutions that are founded on the high availability, fully connected access to medical expertise, the military and NASA are looking for solutions that are distinctly unique within the healthcare industry.”

Over the course of several scientific lab-wide VTC meetings, TATRC and the NASA HRP Team discussed portfolios, common research objectives, as well as future goals with each other. Additionally,



TATRC Deputy Director, LTC(P) Justin Stewart, participated in an inter-agency panel at the 2020 NASA HRP Investigators' Workshop that examined NASA and Army medicine parallels.

Ms. Little was the first of TATRC's staff to be invited to participate in the 2018 panel discussion entitled “SpaceCom 2018” at NASA's Houston Lab with a distinguished panel of NASA researchers. The cross-collaboration with NASA has grown quickly since then, and earlier this year, TATRC and NASA got their first joint project funded. With TATRC as the lead, and the NASA HRP team providing letters of support, their new research topic on ‘Medical Data Prioritization in Austere Environments’ was just approved, and will hit the streets this coming fall. The intent of this research will be to explore ways to prioritize specific clinical data elements to determine which should be transmitted for remote consultation when the communication options are highly limited; which is something the Army and NASA both know a lot about. This is the first of what is expected to be a number of collaborations toward reaching common goals between TATRC and NASA research teams.

This past January, TATRC's Deputy Director, LTC (P) Justin Stewart, and Ms. Jeanette Little represented TATRC at NASA's 2020 HRP Investigators' Workshop

in Galveston, TX. The theme of the conference was “Human Exploration – Small Steps Lead to Giant Leaps: Translating Research into Space Exploration” and featured over 1,000 attendees, 600 scientists, and 500 presentations. The annual, week-long meeting is a showcase of all of the NASA sponsored research involving technologies and tools to support future, manned space missions.

Two major themes of the NASA HRP research portfolio address asynchronous virtual health tools and solutions for prolonged care in austere environments. The research presented at the NASA HRP forum for these subject areas aligned perfectly with the Army Medical Simulation and Information Sciences / Medical Assist Support Technology (MAST) research task areas (e.g. Medical Robotics and Autonomous Systems [MEDRAS], and Virtual Health [VH]) and therefore, provided a good venue to learn more about research actively underway in this growing area.

Additionally, LTC (P) Stewart was able to participate in an inter-agency panel



LTC(P) Stewart discussing TATRC's new mission and capabilities portfolio with the NASA audience.



LTC(P) Stewart and mHIIC Lab Lead, Ms. Jeannette Little, represented TATRC at the NASA conference in Galveston, TX.

learn more about how NASA leverages research agreements that are similar to Other Transaction Authority Agreements. Understanding how NASA and TATRC conduct research activities, will provide opportunities for mutually beneficial collaborations in the future

LTC (P) Stewart stated, "The 2020 NASA Human Research Program Investigators' Workshop provided a tremendous opportunity to learn about areas that NASA is researching involving care of humans in austere environments. The conference overall, provided a first rate venue to network and explore opportunities where common interests intersect and overlap between the Army and NASA."

An informal goal has been established to find a common research objective between TATRC and the NASA government teams within the next two years to ensure that our research is complementary, and not duplicative in nature. Dr. Baraquiel Reyna, from NASA's HRP Program stated that he is "excited to partner with TATRC to revolutionize the medical care being provided to our Warfighters and astronauts."

This excitement was echoed by LTC (P) Stewart as well, "Whether terrestrial or extraterrestrial, the human is the one going to austere environments. Both the Army and NASA are sending people where there are no medical assets, so we have more in common than people realize. As the Army researches ways to provide medical care in austere environments we can work with NASA to share efforts in novel ways to provide that care. Common areas of interest include, but certainly are not limited to, clinical decision support tools, autonomous robotic systems for surgical support, and ways of providing care where the digital signal is limited. Fusing data, humans and machines is going to take a lot of work and being able to collaborate with NASA is going to be a game changer. I look forward to 'forging the future' with NASA to save lives in space and on the battlefield!" ■■■

presentation and share the DoD's Medical Challenges and how they relate and align with NASA's research for space exploration (e.g. manned missions to Mars et al). LTC (P) Stewart's presentation resonated with the conference participants, who were able to clearly see how technologies for use in space exploration could also be applied for

use on the future battlefield.

Both LTC (P) Stewart and Ms. Little were able to attend a networking session with all of the NASA HRP lead scientists, and met with NASA HRP's "techwatch" and research execution partners at Baylor Medical Center and the Potomac Group. This conference was an opportunity to

TATRC Research Supports U.S. Navy Bureau of Medicine and Surgery

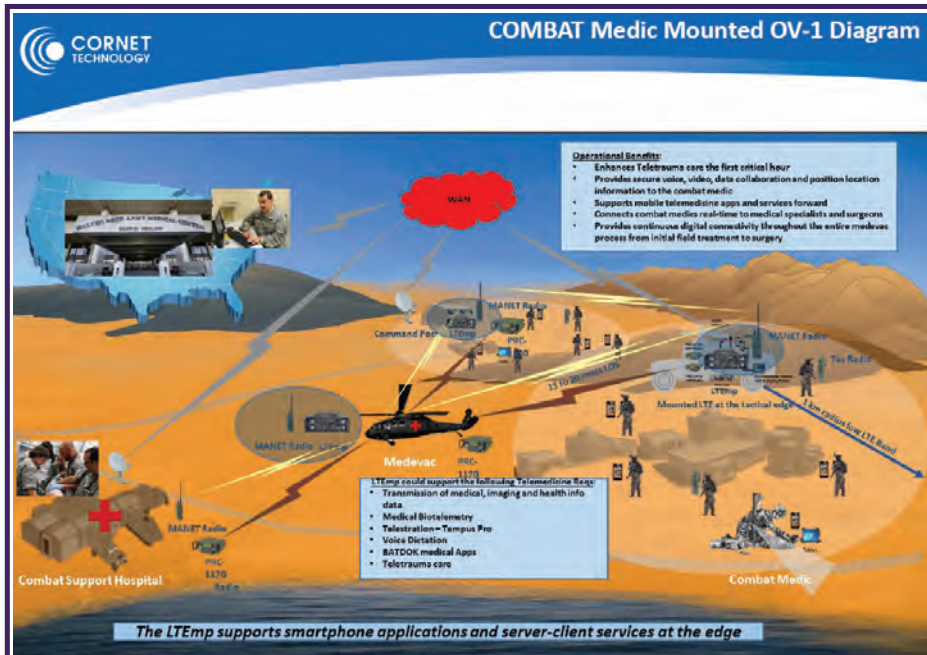


Diagram and Operational View of the Mounted Combat Medic Capability.

On 10 January 2020, TATRC supported the U.S. Navy Bureau of Medicine and Surgery's (BUMED) effort along with the John Hopkins Applied Physics Laboratory (JHU/APL) to characterize the use of the CORNET STINN 4G LTE Manpack Radio for use as a communications enabler for Virtual Health in a tactical environment.

During this one-day, outdoor field event hosted by TATRC, both U.S. Navy Hospital Corpsmen and Army Combat Medics teamed up to respond to medical scenarios where they jointly supported the care and treatment of a severely burned casualty in a simulated prolonged field care scenario. The medical teams used telemedicine technologies to reach back to clinicians at both Fort Detrick and to the Naval Medical Center in San Diego to receive mentorship and guidance allowing them to perform a simulated escharotomy. These

clinical scenarios not only offered one-to-one training between a Physician and enlisted medical personnel, but also provided the network data that is required to characterize performance of the systems being studied.

During this event, subject-matter experts from two of TATRC's key labs, demonstrated the maturation of capabilities to exploit network monitoring tools to characterize medical device network bandwidth requirements and the environment of the data collection event network. In addition to demonstrating TATRC's network measurement capabilities, this event allowed TATRC staff to perform internal process improvements for performing reliable and accurate measurements to include validation of different tools for spectrum analysis, bandwidth capacity measurement, bandwidth utilization, jitter, and latency. The data obtained during this event showed that the telemedicine

capabilities employed did not challenge the communications capabilities of the CORNET STINN 4G LTE Manpack Radio. These data collection capabilities will be employed in future data collection events to provide a characterization of the network environment and clinical device network requirements, if applicable for the study.

Performance improvement efforts were not limited to just the technical aspects, but also looked at internal processes for planning and execution of the data collection event. The study allowed for refinement of TATRC data collection processes before, during, and after execution of medical scenarios that will help identify the clinical impacts on patient care of emergent medical technologies. These improvement efforts will increase the quality and responsiveness of research endeavors to quickly answer Requests for Information from senior leaders.

The value of these exercises also go beyond performance improvement and research to answer senior leaders' questions. These exercises also provide invaluable training opportunities for medical personnel to be challenged with medical scenarios that exceed their levels of training and scope of practice, and the opportunity for one-on-one instruction from Physicians through the use of telemedicine. U.S. Navy Captain Valerie Riege, Chief Innovation and Integration Officer at BUMED, highlighted the value of these experiences for all participants by stating, "Thank you very much for hosting the BUMED team for this highly interactive and immersive training session. The remote location, coupled with your excellent coordination, expertise, and willingness

BUMED continued to page 11

TATRC's mHIC Office Recognizes Mr. Nate Montgomery as Q 2 Employee of the Quarter

Mr. Nathanael "Nate" Montgomery is the Mobile Health Innovation Center's (mHIC) Employee of the Quarter at TATRC's Fort Gordon office, in Augusta, Georgia for Quarter 2. Nate works as a mobile developer at the mHIC and is directly responsible for the mobile app design, deployment and feature updates for the lab's Mobile Health Care Environment (MHCE) system. Nate is a hard-working, self-motivated employee who comes to work every day focused on making a difference.

Nate has worked in TATRC's Fort Gordon office since October 2014, when he first began as a college intern, and matured his role into a full time position. Nate performs critical cross platform mobile development work, and has a keen eye for detail when it comes to making both iPhone and Android based solutions integrate with the highest security standards for TATRC. A dedicated employee, Nate continuously pushes for better and better solutions, and is a great team member in the Fort Gordon office.

In the last quarter, Nate has done a tremendous amount of design work for the National Guard Bureau's (NGB) branded instance of the secure mobile app 'PR2ME,' which directly interfaces with the MHCE system. His feature designs and hard work have won him high praise from the NGB senior commanders, since he had provided them with every feature they requested in preparation for a state-wide launch of PR2ME in Maryland, well ahead of schedule.

One accomplishment that particularly stood out earning Nate the employee of the quarter status for this period was Nate's determination and sustained engagement in finding a solution while supporting the Defense Health Agency's (DHA) Virtual Health PM office for the Virtual Medical Center (VMEDCEN) teams who utilize the MHCE system currently. When the MHCE system was launched for remote health monitoring for diabetic patients, to avoid having patients manually enter their blood glucose readings, a Bluetooth enabled glucometer was provided with supplies to each patient. To continue to collect remote health data from patients who did not have a Bluetooth enabled glucometer, Nate was able to successfully field a solution by finding a bluetooth meter accessory compatible with the DHA formulary issue Freestyle Lite glucometer, enabling patients to transfer the blood glucose reading to a secure mobile app without the patient having to do any manual entry, which was a significant



Mr. Nathanael "Nate" Montgomery is the Mobile Health Innovation Center's (mHIC) Employee of the Quarter.

accomplishment. By using this accessory device, there will be no recurring supplies or additional specialty equipment that will be needed by the patient or by the DHA VMEDCEN teams to maintain this level of remote oversight. Nate's solution to this problem for the DHA VH PM office has the potential to save the DHA VH office hundreds of thousands of dollars in supply costs for the remainder of this fiscal year.

Because of his tenacity and focus on finding a practical solution to a real world problem as an additional duty this quarter, we want to recognize Nate with the Employee of the Quarter, for his contributions!

We congratulate Nate and on behalf of our entire team, thank him for this outstanding accomplishment! ■■■

BUMED *continued from page 10*

to support our demonstration resulted in an extremely productive day for all who attended!"

Execution of clinical scenarios in which data is being collected to answer leadership and program manager questions with government validated reproducible data, is resource intensive and a complex endeavor. Continued

execution of these types of scenarios with incorporated internal process improvement, will result in an MRDC capability to perform early research to help inform material development decisions through employment of matured and repeatable processes. ■■■

Employee Spotlight

TATRC Congratulates Q - 2 Employee of the Quarter, Mr. Rob Chewning!



Mr. Robert "Rob" Chewning, Project Manager/Project Officer with the Mobile Health Innovation Center.

Congratulations are in order for Mr. Robert "Rob" Chewning for being named TATRC's Q2 Employee of the Quarter. Rob is a Project Officer with the Mobile Health Innovation Center (mHIC) and serves as the on-site lead and supervisor for all of TATRC's Project Officers. In this past quarter, Rob has worked tirelessly to engage the DHA VH PM Office team, the DISA team, the WTC and NGB customers to ensure that all documentation required for the MHCE system documentation is in order and populated in the DHA portal in anticipation of the formal system migration to the DHA VH PM office.

In general, Rob is a dedicated, organized and tenacious member of the TATRC team. His persistent diligence has paid off, and as a frequent ambassador

for TATRC, Rob consistently reflects admirably upon the values of TATRC; upholding TATRC's reputation for innovation, professionalism, and diligence.

Rob is a mentor within TATRC, and provides direction and guidance to the project officers within the organization. His quiet, calm demeanor is valued across TATRC.

Rob's consummate professionalism, keen intellect, and kind spirit make him the ideal team member within TATRC. Furthermore, Rob is as humble as he is capable, and is one of the true unsung heroes within TATRC.

Congratulations Rob on this well deserved achievement! 

TATRC Welcomes NEW Artificial Intelligence & Machine Learning Engineer



Dr. Amy Papadopoulos, D.Sc., AI & Machine Learning Engineer for Medical Intelligent Systems Lab.

Dr. Amy Papadopoulos, D.Sc. joins the TATRC team to support the MISL Lab as the AI and Machine Learning Engineer. The desire to help others has been a significant factor in many of Amy's life decisions and she believes that joining the TATRC team will allow her to continue on this path. She is excited to have the opportunity to do research at the forefront of technology in support of the Warfighter.

Before joining TATRC, Dr. Amy Papadopoulos split her time between teaching at George Washington University in the Biomedical Engineering Department, serving as Chief Technology Officer of Syndesy Technologies Inc, and managing Loudoun International Fencing Club. At GWU she was responsible for developing and then teaching Matlab and C programming courses to biomedical engineering students with an emphasis on

biomedical applications. At Syndesy technologies, a start-up making GPS trackers, she was responsible for developing the firmware for the prototype as well as a few customer-specific modifications as the company entered the market. Finally, as owner of Loudoun International Fencing Club, which she started in 2015 for her daughter (now a Varsity fencer at Duke University who won Bronze at the ACC Championships last year!) she was and still is responsible for "everything except coaching."

Born in San Diego, CA she grew up in Northern Virginia, graduating from Langley High School. She went on to study at the University of Virginia where she received her B.S. in electrical and computer engineering. After graduating from UVA, she moved to Italy and then Germany, spending three years in each country learning the language and culture while working as both a firmware developer and field application engineer. Upon returning to the United States she returned to school at the University of California, Santa Barbara to earn her M.S. in computer engineering, with a concentration in fault tolerance. After graduation she began working for Tandem Computers as a software designer and was lead on a project to implement process-pair replacement that Tandem eventually patented.

Amy left Tandem to have her two children who are her pride and joy, daughters Maria and Eleni. While pregnant with Eleni, Amy moved back to Munich, Germany with her husband where they spent 3 years before moving to Ashburn, Virginia. While back in Munich, Amy did some part time work developing GSM applications.

Upon moving to Virginia, Amy

worked as a senior software developer for Call Technologies, a company making voice mail systems. After a few years, the desire to do something that "could help people and make a difference in the world" grabbed her and she returned to school, pursuing her doctorate in biomedical engineering from George Washington University. Her doctoral dissertation was entitled, "Texture Analysis of Optical Coherence Tomography Images of the Urinary Bladder for the Recognition and Staging of Bladder Cancer," and served as her introduction into the world of research.

After defending her dissertation, Amy joined Aframe Digital, Inc. as their senior research scientist where she was the principal investigator on a number of NIH SBIR's and other grants. AFrame specialized in devices and systems for telemedicine focusing on the elderly and chronically ill. She led their research in areas such as predictive modeling, activity monitoring, gait analysis and fall detection, and was particularly interested in recognizing changes in patterns which could be indicative of an increased fall risk or declining medical condition.

Over the course of her career, Amy has been the recipient of a scholarship from the ARCS foundation, been co-developer on three patents, and has authored several papers published in peer-reviewed journals.

We here at TATRC are honored to have someone so dedicated to the field and future of technology working with our innovative team! Welcome to TATRC, Dr. Papadopoulos! ■■■

Employee Spotlight

TATRC Adds a Robotics Engineer to the MISL Team

Mr. Ethan Quist is the latest new hire to join the TATRC team as a Robotics Engineer working in our MISL lab supporting our Robotics efforts. He has recently graduated from the University of Maryland, College Park, with a M.Eng. in Robotics. While there he concentrated in Medical Robotics and Rehabilitation Robotics. Over the summer, Ethan conducted research with his professor on a novel Ankle Robot that rehabilitates stroke victims and improves their mobility and balance.

Before Maryland, Ethan attended Clemson University for his bachelor's degree, where he was (and still is) an avid Clemson Football fan. There he studied Computer Engineering

and co-op'ed with BMW Manufacturing in Spartanburg, South Carolina. After undergrad, Ethan worked in Greenville, South Carolina for 4 years as a controls systems integrator. Some of his major contracts were locally with BMW and GE Gas Turbines. As a controls systems integrator, Ethan programmed PLCs for automation in assembly plants as well as programmed manufacturing robotics. He decided to go back to school at Maryland to focus his career in Medical Robotics.

Ethan grew up in Doylestown, Pennsylvania, north of Philadelphia. He played lacrosse in high school and wrestled for most of his life. Aside from Clemson Football, he is a big fan of the Philadelphia Phillies and enjoys all of baseball. In his free time, he loves live



Mr. Ethan Quist, Robotics Engineer for Medical Intelligent Systems Lab.

music and going to shows. Excited to be out of the library from studying, Ethan plans on spending his free time exploring the areas around Maryland / Virginia / West Virginia, hiking and backpacking.

TATRC warmly welcomes its new member, Ethan! ■■■

TATRC Welcomes a NEW Project Officer to the Team!

Mr. Oliver Allen joins the TATRC Team as a Project Officer. He will primarily be supporting the MISL lab and their projects by assisting with research and collection and filing of communications and reports.

Born and raised in Baltimore, Maryland, Oliver joined the Army in 2008 where he served as a Paratrooper with 4th Brigade, 82nd Airborne Division and deployed once to Afghanistan in support of Operation Enduring Freedom in 2009. After leaving active duty, Oliver attended Towson University where he earned his Bachelor of Science degree in Biology, with a concentration in Molecular Biology. While earning his degree,

Oliver also served with the Maryland Army National Guard, first working in operations with brigade headquarters before becoming a 68W and working with the state medical detachment at Camp Fretterd, MD. After graduating, Oliver moved to Frederick and began working at Novavax, a clinical stage vaccine development company, in the clinical immunology department as a Research Associate performing clinical and development testing in support of an RSV vaccine candidate and later, a novel flu vaccine candidate.

In his free time, Oliver likes to enjoy the mountains surrounding Frederick by hiking or preferably mountain biking the trails. Oliver's favorite hobby though, is SCUBA diving, which he has been doing



Mr. Oliver Allen, Project Officer for Medical Intelligent Systems Lab.

since 2015. While Frederick might not be very conducive to SCUBA diving, he does his best to get to warmer waters every year!

Welcome to Team TATRC, Oliver! We're thrilled to have you! ■■■



PROJECT SPOTLIGHT

Use of the RAPTOR System in Outpatient Physical Therapy: A Multi-Site Demonstration Project

Physical therapists regularly evaluate and treat patients with musculoskeletal (MSK) injuries, which is the number one cause of medical non-deployability in military personnel. To effectively treat and manage injuries, physical therapists perform many tests and measures to assess a patient's function, movement, and other factors that contribute to injury and recovery. The importance of measuring and tracking these outcomes has come into focus as one method to demonstrate the value and quality of care that is delivered to Soldiers. This quality of care is directly tied to readiness, as the better and faster we can rehab a Soldier, the sooner they can return to duty. While collecting these outcomes has become the standard of care in physical therapy, the current medical record system is ill-equipped to collect these data, therefore this important information is typically "lost" within a patient's medical record. Without being able to collect and track outcomes, the effectiveness and quality of care that is being delivered is difficult to assess, and thus difficult to improve or impact, at both the individual and clinic level.

To address this problem, the Rapid Acquisition Package for Tracking Outcomes in Rehabilitation (RAPTOR) system was developed at Fort Bragg, within the Womack Army Medical Center (WAMC) clinic by CPT Robert Whitehurst with the support of Advanced Medical Technology Initiative (AMTI) funding. Initial help and support came from LTC James Mills and MAJ Darren Hearn, and continued support comes from COL Don Goss, Dr. Matt Hartshorne, and with input from many clinicians serving at WAMC. The RAPTOR system was built with two goals in mind: collect outcome data on patients treated within the physical therapy clinic and minimize the

burden on clinicians to collect these data.

This was accomplished by building a program that standardizes and automates the process of documenting clinical encounters while simultaneously extracting the useful data from that encounter into a database for analysis. Additional tools, such as normative values for different tests and a medical coding calculator, were built into the system to improve evidence-based care and to maximize medical billing for services performed.

After demonstrating that this system was a viable and useful tool within the WAMC clinic, an AMTI proposal was submitted and accepted to demonstrate that the RAPTOR system could be used at other physical therapy clinics. The funding allowed for further expansion of the capabilities of the RAPTOR system, expanded the number of Fort Bragg clinics using RAPTOR, and aided expansion to Tripler Army Medical Center physical therapy clinics. As the RAPTOR system was continuously improved utilizing clinician and leadership feedback, additional clinics expressed interest and started using the system. Ten clinics and over 60 clinicians are

currently using RAPTOR, and over 100 therapists have used the RAPTOR at some point. Some clinicians liked RAPTOR so much that when they moved away from Fort Bragg, they asked to bring RAPTOR with them! Since March 2017, approximately 25,000 unique episodes of care (a MSK evaluation and all subsequent visits count as one episode of care), and 1.8 million variables of interest have been collected (See FIGURE 1.)

With the ability to easily measure and track outcomes,



RAPTOR continued to page 16

RAPTOR continued from page 15

assessing the effectiveness of patient care has dramatically improved and changes in patient outcomes in response to different initiatives or training can now be analyzed. For example, a direct access to physical therapy without a physician referral initiative, known as the “Sick Call” initiative, was recently introduced at the Robinson Health Clinic at Fort Bragg. Using data from RAPTOR, clinicians can quantify improvements in patient reported function and pain reduction of patients who attend physical therapy through the sick call route versus those

who came through the normal referral process. After 3 months of data collection, we observed that patients are being seen much sooner (6 days vs. 54 days) after injury and 51% of sick call patients had a clinically meaningful change in function compared to 34% from the regular clinic. Without RAPTOR, comparisons like these would not have been possible.

CPT Whitehurst stated, “Analyzing these data has also helped identify and quantify the problem of patients being lost to follow-up (patients who don’t finish their episode of care and aren’t discharged by their therapist). We suspected that this was an issue, but

with the previous tools it was impossible to track or quantify how many were lost. Now with the RAPTOR system, we can show that our discharge rate is approximately 25%. Not only that, we can use the RAPTOR system to identify and track patients that have been “lost to follow-up.” (See FIGURE 2.) Utilizing this information, an additional clinic initiative to create and implement policies and procedures to re-engage with patients was created, thus improving the quality of care and communication with patients. We know that previous injury and incomplete rehabilitation are the greatest predictors of future injury. We will now be able to see if through this initiative we can improve on the current discharge rate and prevent patients from having to go through the medical system multiple times for the same condition.”

Because of the funding from TATRC’s AMTI Program, the RAPTOR system is now able to furnish reports that help clinicians track patients that have been lost to follow-up, show changes in patient outcomes, and identify problems and challenges in patient care. Funding has allowed the expansion from the Womack clinic to clinics Army wide, and the system continues to develop and expand. Future efforts involve expanding the system to incorporate other MSK providers like occupational therapy, and to injury screening efforts within FORSCOM and SOCOM.

“RAPTOR gives us many capabilities not previously possible. My mentor, COL (ret) Joe Moore, taught me to consider every patient as a potential subject. The ability to track outcomes for every patient and to identify those lost to follow up are two capabilities that I am very excited about,” stated COL Donald Goss, OIC, Physical Therapy, WAMC.

Ms. Holly Pavlisca, Program Manager for TATRC’s AMTI concluded that, “The RAPTOR Program is a project that started off as a good idea and is now supporting multiple clinics across the enterprise and is poised to transition and integrate into our current and future electronic health systems.”

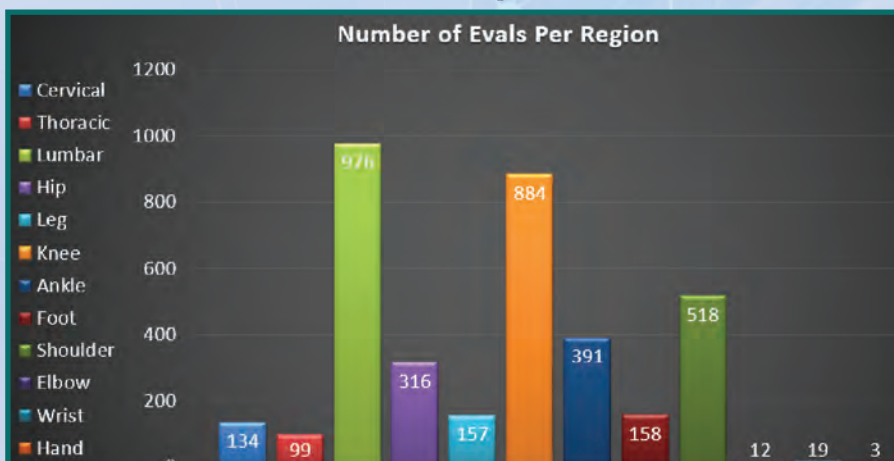


Figure 1. One of the graphs from the RAPTOR database showing the number of initial evaluations from a clinic.

Figure 2. A screenshot of the RAPTOR user interface that clinicians use to document patient care. The colored fields represent data points that are automatically extracted.



PROJECT SPOTLIGHT

Rapid Qualitative Antibiotic Resistance Characterization Using VITEK MS

The emergence of antibiotic resistant organisms pose a significant public health concern. The prevalence of antibiotic resistance especially in Gram-negative bacteria continues to increase globally. Since the beginning of Operation Iraqi Freedom and Operation Enduring Freedom, the U.S. military healthcare system has experienced a notable increase in the number of antibiotic-resistant organisms being isolated from wounded Service Members. Although U.S. military involvement in the Middle East is decreasing, Service Members deploy to areas all around the globe where unique antibiotic resistance exists. Exposures may not necessarily lead to infection, but military personnel could carry these organisms home and potentially spread to others. Rapid, simple, cost-effective, and accurate resistance detection tests are critical for antibiotic stewardship and combating the development of antimicrobial resistance, ultimately improving patient care and maintaining the health and wellness of military members and their families.

Matrix-assisted laser desorption / ionization time-of-flight mass spectrometry (MALDI-TOF MS) is used in a variety of microbiology applications. In clinical microbiology, MALDI-TOF MS has revolutionized the identification of bacteria from a matter of hours or days to just minutes. The instrument is coupled to software which compares generated spectra to profiles stored in a reference library and uses an algorithm to produce an organism



FIGURE 1. VITEK MS (bioMérieux, Durham, NC) MALDI-TOF instrument used for testing.

determination with a score / confidence level. MALDI-TOF MS is routinely employed by many diagnostic laboratories including military treatment facilities (MTFs). The use of MALDI-TOF MS as a cost-effective and rapid technology to determine antibiotic resistance and mechanisms of resistance within a matter of hours has started to gain attention, and a number of promising approaches have been documented in studies to date. Currently, most diagnostic laboratories employ traditional microbiological methods or automated instruments that can take up to 24 hours to provide antibiotic susceptibility information. The development and standardization of rapid and accurate methods to provide faster results, lower costs, and reduce labor requirements are much needed.

With TATRC's Advanced Medical Technology Initiative (AMTI) funding and support of this project, investigators at Tripler Army Medical Center (TAMC) evaluated two unique antibiotic resistance determination assays using the VITEK MS (bioMérieux, Durham, NC) MALDI-TOF instrument shown in Figure 1 for prediction of bacterial antibiotic susceptibility. The Principal Investigator, CPT Tim Horseman explained that "this study is the first to demonstrate antibiotic susceptibility determination using the VITEK MS manufacturer recommended clinical FDA-approved instrument run settings." Ultimately, the suggested methodological strategy eases the implementation, validation, and routine use of these assays in diagnostic laboratories.

This study employed VITEK MS to evaluate a total of 140 isolates, with equal numbers of antibiotic sensitive and resistant strains for the following four clinically significant bacterial pathogens: *Staphylococcus aureus*, *Enterococcus* species, *Escherichia coli* and *Klebsiella pneumoniae*. These bacteria were selected due to their high resistance rates and their role in nosocomial infections. Methicillin-resistant *S. aureus* (MRSA), vancomycin resistant *Enterococcus* (VRE), extended-spectrum beta lactamase (ESBL) *E. coli* and carbapenemase resistant *Klebsiella* (KPC) are commonly observed antibiotic resistant in these organisms. A liquid broth extraction method and a simple direct-on-target microdroplet growth assay (DOT-MGA)

VITEK MS continued to page 18

VITEK MS *continued from page 17*

both involving short incubation of a bacterial suspension with an antibiotic of choice were used to predict antibiotic non-susceptibility. The extraction method required a number of centrifugation steps and washes before the final solution was applied to the VITEK MS target slide. For the DOT-MGA, a microdroplet of each prepared suspension was pipetted to a VITEK MS target slide (Figure 2). The microdroplets were incubated directly on the target slide in a box with water added to the bottom of the box to avoid evaporation and to provide a humid environment for incubation. After incubation, the liquid broth was carefully 'wicked' away from the bacterial cells by touching a wipe to the backside of the microdroplet (Figure 2). Sensitive or non-susceptible interpretations were based on the standard clinical VITEK MS software confidence levels intended for identification of organisms. For bacteria treated with antibiotic, non-susceptible interpretation was a score of $\geq 90\%$. Conversely, a non-identification on the VITEK MS was interpreted as a susceptible result. Growth controls with no antibiotic were tested for each bacterial strain and required a successful identification, $\geq 90\%$, for the tests to be deemed valid (Figure 3).

The liquid extraction method and DOT-MGA proved to be reliable assays for *K. pneumoniae*, *E. coli*, and *S. aureus* isolates providing consistent differentiation between non-susceptible and susceptible strains. The liquid extraction method for the Gram-positive and Gram-negative bacteria tested allows for a shorter incubation time, 2-3 hours, than the DOT-MGA, 4-5 hours. The extraction method is advantageous because it seems to be more consistent over a wider range of organisms with inclusion of concentration and cell lysis steps. Extracts can also be stored at -80°C for reference or retest if applicable. The DOT-MGA offers a less laborious, and more cost-effective method for antibiotic resistance determination on VITEK MS than the extraction assay. It also minimizes the opportunity for human error since there are less steps and technician hands-on time. Both methods are equally as sensitive and



FIGURE 2. The experimental setup detailing VITEK MS target slide with microdroplet before incubation. Columns 1 and 2, growth controls; columns 3 and 4 are isolate with antibiotic. Separation of non-selective broth from bacterial cells using a kimwipe as absorptive material.

Accession ID	Organism Name	Confidence Value	Confidence Level	Review Status
1/10-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/10-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/12-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/12-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/13-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/13-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/14-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/14-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/15-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/15-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/16-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/16-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/17-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/17-1-1	Klebsiella pneumoniae	99.9	High	Discarded
1/18-1	Klebsiella pneumoniae	99.9	High	Reviewed
1/18-1-1	Klebsiella pneumoniae	99.9	High	Discarded

FIGURE 3. MALDI-TOF MS spectra were acquired on a VITEK MS using routine FDA-approved IVD manufacturer recommended settings. Susceptible and non-susceptible interpretation was based on confidence value threshold.

specific, the promise of each lies in their adaption for clinical diagnostics.

Overall, the extraction assay and DOT-MGA can provide necessary information to clinicians prior to the release of an organism's full susceptibility profile and within the same day from isolated colonies. Further investigation and standardization of assays with the VITEK MS are important moving into the future. Testing regionally and genetically diverse isolates should be performed to challenge the reliability of the profiling methods suggested in this study.

Future enhancements to the assays most notably include assay automation allowing more consistent and rapid sample processing. Results from this study support VITEK MS and these assays as rapid and accurate tools to augment traditional susceptibility testing. Furthermore, these results lay the foundation for a larger, multi-site study to determine feasibility of implementation across MTFs. If implemented clinically, these assays can reduce the cost of patient care and the time to deliver critically needed treatment. ■■■