NEWSLETTER

HPT&B

HUMAN PERFORMANCE, TRAINING, AND BIOSYSTEMS DIRECTORATE

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Technology Solutions for Combat Casualty Care Training

By LTC Dawn C. Fitzhugh, VMD, MPH

In combat, enlisted medical personnel (medics) are DoD's first responders, providing care to casualties where they are injured. Depending on the ongoing mission and types of injuries, medics may be responsible for moving combat casualties out of immediate danger, keeping the airway open, ensuring breathing, controlling blood loss, and managing pain all while they may be injured themselves and still in harm's way. When they are not deployed, medics may have limited opportunities to perform lifesaving skills and manage multiple trauma casualties primarily due to the restricted scope of practice for non-licensed providers. Although the DoD partners with civilian hospitals for trauma training, this provides a much different learning experience. Civilian first responders are typically within minutes of sophisticated emergency rooms with highly specialized medical providers and supporting staff. Civilian first responders utilize equipment that is not available on the battlefield and the type of wounds

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HPT&B TECHNOLOGY FOR HUMANS

In the Human Performance, Training, and BioSystems (HPT&B) Directorate, we believe that Department of Defense (DoD) technologies are developed to extend the capabilities of the human, enhance the capabilities of the human, sustain the human, or repair the human.

Visit www.acq.osd.mil/rd/hptb for more information on the HPT&B Directorate.

From the Desk of Dr. Patrick Mason, Director HPT&B

Patrick A. Mason, Ph.D.
Director
Human Performance, Training, and BioSystems Directorate

My team and I hope you enjoy the third edition of the HPT&B newsletter. Our focus on medical research and development (R&D) in this edition of the HPT&B newsletter is timely, coinciding with DoD's response to the Ebola outbreak in West Africa. As outlined in Dr. David Simon's article, DoD's R&D investment in Ebola and other emerging diseases continues to pay off; providing important capabilities such as rapid diagnostics, vaccines, therapeutics, patient evacuation systems, and personal protective equipment. Many of the DoD organizations executing Ebola-relevant R&D have worked together to coordinate their efforts and expedite the transition of technologies for use in the current Ebola outbreak. As RADM Bruce Doll emphasizes in his article on military medical research, the DoD medical research community is large and diverse and coordination is imperative to developing and transitioning capabilities. The Armed Services Biomedical Research Evaluation and Management (ASBREM) Community of Interest (COI) provides the necessary venue for DoD medical research community to come together to communicate, coordinate, and collaborate.

This newsletter highlights some of our efforts to bring together the R&D and operational communities. One such effort was the organization of the Autonomous Patient Transport workshop in August. This newsletter also provides the opportunity to highlight some of our visits to see your research efforts and facilities. Finally, we continue to engage at the international level. We provided a summary of the recent India-U.S. Cognitive Sciences/Autonomy Workshop and Directed Energy Workshop.

We look forward and encourage your active participation in our Newsletter. Please send your comments, suggestions and success stories to: Jennifer.r.coughlin.ctr@mail.mil.

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they treat may be very different from those that a medic will manage.

Development of skills for combat casualty care can be viewed as a system of systems working together for optimal training. At the core of the system is the curriculum with learning objectives and desired knowledge that impacts casualty care on the battlefield. This core system includes classroom and distance learning with lectures or other didactic materials to build the cognitive knowledge for medics to perform in accordance with established service-specific doctrine. The next step builds upon the curriculum and cognitive knowledge to obtain proficiency in certain medical techniques by engaging training systems using task trainers, manikins, and other modalities. Task trainers, manikins, browser-based virtual reality, and other simulation systems allow medics to practice procedures repeatedly, such as tourniquet placement, until they achieve competency and then proficiency with individual tasks. Once the cognitive and psychomotor skills have been developed, advanced simulator systems and moulaged actors can be used to integrate multiple skills, improving proficiency, knowledge, and confidence.

The external environment and individual stressors must then be considered in providing optimal training integrated along the training progression and incorporated in many of the culminating events. To that end, DoD trains as it fights; combat trauma training occurs on the ground, in tents, in the rain, snow, or heat using the actual equipment that the medic will take onto the battlefield. In addition to the environmental conditions, additional stressors may be added to training to create realistic scenarios. These stressors include an increased complexity of the combat-relevant injuries, increases in the number of injured, and/or an incorporation of different team dynamics.

In the virtual world, the National Capital Area Medical Simulation Center in Forest Glen, Maryland and the Medical Readiness Training Center at Camp Bullis, Texas both have Wide Area Virtual Environment (WAVE) training systems. In this virtual world, the sights, sounds, smells, and stressors of the battlefield immerse medical personnel in an environment that simulates the fog of war. Together these systems provide the medic with the knowledge and skills to perform their duties. However, a gap remains between the skills that can be gained using the most advanced simulation systems and the proficiency and confidence that translates to performance and resilience on the battlefield.

In some medic training programs within DoD, animals are used in a capstone, pre-deployment event to build resilience and train for performance on the battlefield. At each institution that uses animals, an animal care committee must assess the use of the animals for training with the associated benefit. The committee's mission is to ensure responsible use of animals, consistent with federal laws and DoD policies, while providing the best medical training possible to save the lives of Service men and women. These committees make decisions within the bounds of regulatory guidance that includes the Animal Welfare Act, the federal law that applies to use of animals, and DoD policies. DoD policies (DoDI 3216.01 and DoDI 1322.24) limit the use of animals in training, allowing their use only when alternatives such as task trainers and manikins are not sufficient to adequately train personnel. Animal care committees review and assess the scientific literature related to the training in order to guide their decisions regarding the use of animals. While the DoD is sponsoring numerous projects to build evidence-based decisions, there is difficulty in designing a scientific study to accurately

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quantify the impact that the animal brings to training. Current medical success on the battlefield, subjective feedback from medics, and guidance from experts in medical training must be considered in the decision to include the use of animals in a comprehensive capstone event prior to deployment. These decisions by animal care committees remain a delicate balance of logic and emotion. Removing the animal from DoD medic training could degrade the quality of combat casualty care on the battlefield, leading to an increase in combat fatality rates.

In order to advance the state of medical science in those areas of most pressing need and relevance to today's battlefield experience, the Assistant Secretary of Defense for Health Affairs (ASD(HA)) established the Defense Medical Research and Development Program (DMRDP). One of the goals of the DMRDP is to discover and explore innovative approaches to accelerate the transition of technologies to ensure the most effective medical training systems for the DoD. Under the DMRDP, the Joint Program Committee-1 (JPC-1) is responsible for Medical Simulation research. The

Air Force personnel work with the Tactical Combat Casualty Care Cut Suit. The cut suit can be worn on a human or simulator to simulate severe traumatic situations for medical training environments.

JPC-1 was established in fiscal year 2010 to provide recommendations for research related to medical training and education efforts to advance the development and integration of simulation-based training systems.

The JPC-1 has several ongoing projects to advance simulation-based systems for combat casualty care training. Work in this area began in 2011 by addressing the need for improving knowledge of curricula and simulation modalities. These initial research initiatives were to: identify training gaps when using simulation technologies, determine objective evaluation criteria for trainees, compare current simulation systems (e.g., simulators and animals) with end user needs; identify metrics by skill or procedure; and determine which metrics discriminate between users. As these early studies begin to conclude, this knowledge base will provide an initial means to compare training effectiveness across a spectrum of modalities to include manikins and animals.

While such projects contribute to knowledge of how to optimize training curricula, research in other areas examines improved material solutions for simulation in combat casualty care training. One such product is the multiple amputation trauma trainer, or MATT® which successfully transitioned from a research effort (U.S. Army Research, Development and Engineering Command, Simulation and Training Technology Center (RDECOM-STTC)) to a product in use today at medical simulation training centers (MSTCs). The MATT© product trains medics to respond to severe lower extremity injuries, managing hemorrhages and amputations. A similar ongoing effort is the development of an

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Airmen train Aug. 22 using the Multiple Amputation Trauma Trainer (MATT) at David Grant USAF Medical Center

advanced modular manikin with interchangeable core and peripheral components of varying fidelity that will meet the needs of core and tailored curriculum for the trainees.

Providing products of high fidelity will improve the realism of simulation-based training systems for combat casualty care. In both the virtual and physical world, JPC-1 has recommended studies to understand the complex mechanisms of tissue biomechanics and human physiology. The desired long-term outcome is the development of simulation-based systems that realistically replicate a human response to medical procedures--be that a physical examination, application of a tourniquet, placement of an intravenous catheter with subsequent administration of medications, or all the way to complex multiple injuries where not only does it matter how to treat, but also the order in which to treat. The ideal product will not only look and feel like a human being, but will replicate the complex physiologic responses of a living being, responding to medical interventions with realistic variations in heart rate, blood pressure, breathing, and other parameters all based upon the level of injury. Such high fidelity, physiologically relevant systems must also be untethered and rugged enough to endure the DoD's training environments. Ongoing research into the training environment will help the DoD train medics in situations that are optimally stressful, providing the right combination of factors external to their "patient" that will prepare them for their roles on the battlefields of the future with the resilience to endure the reality of combat casualty care.

Through ongoing research efforts, the DoD is improving knowledge of how to best assess and compare training platforms for combat casualty care, developing improved materiel solutions for non-animal alternatives in both the physical and virtual world, and creating optimal environments to train ready, resilient medics. Standing alone, each of these systems aids in the overall learning experience. Combining these individual systems into one overarching system creates a robust learning atmosphere, fully engaging the medic mentally, physically, and emotionally. Many of these advancements will likely be applied to medical simulation systems used by other extramural healthcare providers, as well as by other Government organizations, such as the Department of Homeland Security (DHS) or the Federal Emergency Management Agency (FEMA) to prepare for human-made or natural disasters. To this end, the DoD continues its research efforts and is interacting with industry, academia, and international partners to meet the challenges that come with learning in a simulated environment to best prepare medics to care for the combat-wounded warfighter.

Armed Services Biomedical Research Evaluation and Management (ASBREM) Community of Interest (COI): Promoting Synergy in DoD Biomedical Research, Development, and Acquisition (RDA)

DoD's investment in biomedical research, development, and acquisition (RDA) efforts encompass a broad range of research areas to include combat casualty care, military operational medicine, military infectious disease, medical radiological defense, clinical and rehabilitation medicine, medical informatics, and training and simulation. The ASBREM COI, established by the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)), is working to promote coordination and synergy of the various DoD biomedical RDA efforts. In addition to promoting long-term strategic coordination of biomedical RDA, the ASBREM COI supports DoD's efforts to respond quickly to address emerging biomedical RDA challenges and issues. Over the past few months, the ASBREM COI provided a venue for various DoD components working on Ebola RDA to communicate, coordinate, collaborate, and expedite Ebola relevant technology to deal with the current Ebola crisis in Africa.

The Director, RDA Directorate, Defense Health Agency (DHA) serves as the ASBREM COI Chair, assuring that the leadership rotates among the services in the same manner as the DHA RDA Director's position on a 2-3 year basis. The current ASBREM COI Chair, Rear Admiral Bruce Doll, shares his thoughts on military medical research in this edition of the HPT&B newsletter.

RADM Bruce Doll is dual-hatted as the Director of the Research, Development and Acquisition Directorate at the Defense Health Agency, Falls Church, VA, and Deputy Commander of the U.S. Army Medical Research and Materiel Command, Fort Detrick, MD.

Military Medical Research: Striving Forward Together

By Rear Admiral Bruce Doll

DoD has excelled in medical research since the early 19th Century when Major Walter Reed, M.D. discovered that yellow fever is transferred by mosquitos instead of person-to-person contact. It was this crucial medical finding which helped the U.S. government effectively fight the disease, finish building the Panama Canal, and usher in an age of trade and naval dominance. Military medical research has come a long way since Dr. Reed's days – but is just as, if not even more important in the 21st century. Not only have we achieved amazing scientific breakthroughs, but the size and composition of our research force has also broadened greatly. We have fostered a community that includes every Service branch, numerous U.S. government agency partners, universities, and the private sector. This diverse community's work has contributed to the lowest combat death rates in military history. However, we still have work to do, and areas that we can perform in even better.

In June of 2014, the DHA welcomed the RDA Directorate into its fold with the goal of tying together the military research community to better coordinate efforts that benefit the entire enterprise. Each Service and group working in military medical research fills a vital role in the mission of ensuring our troops' safety and readiness - but at times some roles overlap, which can stifle collaboration or cause redundancy. The RDA will focus on creating a comprehensive approach to support developing and delivering joint capabilities to our warfighters through common processes, and increasing cross-Service and interagency coordination.

One of the first issues we're tackling within the RDA is to make a single series of processes and functions that will affect Military Health System (MHS) in two ways. The first will be for different research components of the MHS to have interoperable research execution methods. This will increase the ability for collaboration as well as give researchers a tool to study lessons learned from across the RDA enterprise. The second goal is to standardize the processes for research project prioritization and execution. Sometimes research projects can go overfunded or underfunded for too long – having a uniform ranking of priorities overseen by RDA will create a more efficient and open pool of research. Both of these initiatives will also give a

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heightened level of visibility to the RDA on all projects for comparison, lending us the oversight ability to reduce research overlap and advance medical science and technology (S&T) more effectively.

Another problem with military medical research is the tendency to silo ourselves off into different departments and specialized technical areas and approaches. This isolation can hamper even greater potential outcomes. In the military medical research community, RDA wants to be the connecting bridge that reminds everyone we're one big team working together to create medical solutions and transfer them to the line. When facing situations like we see with the Ebola virus in West Africa, it's more important than ever that we build on each other's strengths. Under the direction of RDA, the coordination and standardization of military medical research, development and acquisition as well as the improvement of processes can lead to enhanced scientific solutions to big problems.

If you wish to go fast, go alone, but if you wish to go far – go together!

DoD Ebola Research Investments Poised for Impact

By Dr. David Simon

With the largest Ebola outbreak ever recorded in West Africa, ongoing DoD research investments in Ebola-specific and emerging disease areas are poised to alter the response landscape. Within the areas of diagnostics, vaccines, and therapeutic treatment, DoD research is leading the way forward.

Major capability investments from Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs (OASD (NCB)) and the Defense Advanced Research Projects Agency (DARPA), as well as work done by U.S. Army Medical Research Institute for Infectious Diseases (USAMRIID) are critical in determining how the global response to the Ebola outbreak will be carried out over the coming year. For example, the EZ1 Ebola detection kit, funded by the Defense Threat Reduction Agency (DTRA) and the Joint Science and Technology Office for Chemical and Biological Defense (JSTO), developed by USAMRIID, and transitioned and manufactured by the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD),[1] should allow for more rapid detection of Ebola-infected individuals, as well as monitoring for cases of infected personnel traveling into the United States. As a major step in this effort, the EZ1 Real-Time PCR Assay for Ebola Zaire detection was given Emergency Use Authorization approval by the Food and Drug Administration (FDA) earlier this year.[2]

In addition to diagnostics, the DoD has also focused on advancing previous investments for Ebola vaccines and therapeutics. With funding from DTRA and testing at USAMRIID, the BioCryst[3] nucleoside analog drug, BCX4430, has shown promising results when tested in non-human primates following infection of the Marburg virus.[4] Since this drug works in a broad-spectrum manner to obstruct virus replication, it is hoped that it will be similarly effective against Ebola. Transition funding by the Department of Health and Human Services (HHS) will provide for a Phase I Clinical Study of the BioCryst drug beginning this year.[5] A second therapeutic, TKM-Ebola, developed by Tekmira[6] was funded beginning in 2010 by JPEO-CBD (with studies done in collaboration with USAMRIID). This RNAi based therapeutic has been previously tested in non-human primates, and began a Phase I Clinical trial in 2010. While an earlier hold on clinical trials were reported, the FDA has since released the hold for emergency use and the study has continued.[7, 8]

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Photo courtesy of Randal Schoepp, USAMRIID

Technicians set up an assay for Ebola within a containment laboratory. Command, Fort Detrick, MD.

A third therapeutic developed with DoD funds is the anti-Ebola antibody cocktail from Mapp Biopharmaceutical[9], known as ZMapp. Originally funded by DTRA in 2011, the unique manufacturing process providing for ZMapp was developed under a different DoD funded program. Specifically manufactured in *N. benthamiana* (a relative of the typical tobacco plant), ZMapp is produced by a platform-capability that was enhanced and live-fire tested under funding from DARPA's Blue Angel Program. Kentucky BioProcessing[10] (now a subsidiary of Reynolds American Inc.) was a performer under DARPA's Blue Angel program, which was developed as response to the 2009 H1N1 outbreak. Additional funding by DTRA and HHS will provide further testing and scaling of the therapeutic.[11, 12] Importantly, recent studies carried out in collaboration with USAMRIID, displayed the protective capability of ZMapp for up to 5 days post-infection of non-human primates.[13] The renewed DTRA funding will allow for the first Phase I or Phase II Clinical Trials of the ZMapp drug to begin, hopefully extending the previous results to humans while ensuring the safety of the product. While headlines have highlighted the use of the ZMapp therapeutic by several Ebola patients, without Phase I and/or Phase II Clinical Trials, the limited number of persons receiving the drug does not provide a definitive answer as to its effectiveness.

The therapeutics and diagnostics described above are just a few examples of the medical countermeasures funded and expedited for the current Ebola epidemic. The suite of options under development within the DoD pipeline for vaccines, therapeutics, and diagnostics, have the potential to create direct, positive impact on the current Ebola crisis and beyond.

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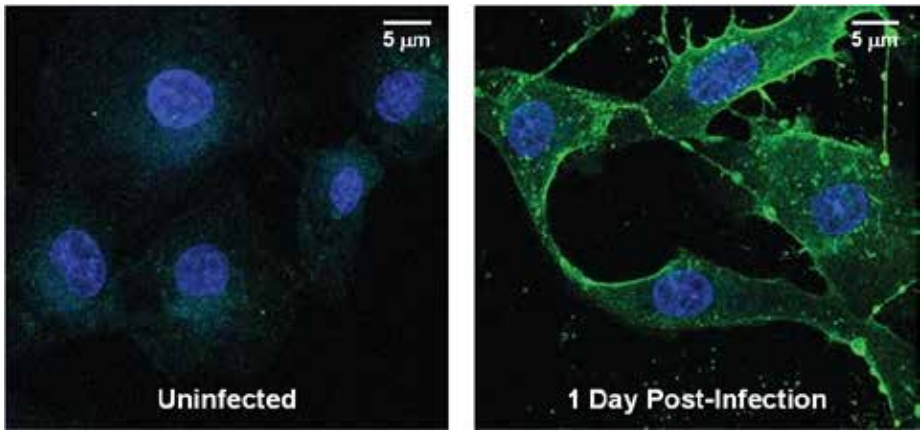
Basic Research Corner: Fundamental Discoveries Drive the Future of Antiviral Therapy

By Dr. Kelby Kizer and Dr. Robert Kokoska, Army Research Laboratory – Army Research Office

Regardless of the duration or scale, viral infections harm Warfighter health, performance and morale. These threats can originate as natural viral strains or engineered strains used by an enemy. Despite the variety of antiviral vaccines and therapies currently available, the rapid pace of viral adaptation and the risk of biological attack in certain regions necessitate new approaches for future antiviral therapies.

Extramural basic research funded by the Army Research Laboratory's (ARL) Army Research Office (ARO) identified a range of mechanisms responsible for viral growth and led to the discovery an unprecedented method to inhibit viral replication.[1-7] These findings may lead to the next generation of antiviral therapies to protect the Warfighter.

These discoveries were pioneered by Professor Benjamin tenOever at the Mount Sinai School of Medicine. While a graduate student, tenOever was one of the first to discover a unique series of signals through which



Rapid Viral Replication. These optical microscopy images reveal how quickly an RNA virus will replicate in human cells, producing copies of new virus for infection in other cells. The images display uninfected human cells (left), with each cell nucleus stained blue and cells ~1-day post infection (right), with viruses stained in green. [Adapted from Shapiro, et al., 2010]

cells detect and respond to invading viruses.[8-9] ARO recognized tenOever's innovative ideas early in his career and has supported his research since 2008.

Dr. tenOever's research builds on the fundamentals of viral biology. Once a virus enters a human cell, it begins reprogramming the cell to replicate the virus' structure. Most viruses encode their genes using RNA, and release their RNA genes into cells during the infection process.

Cells use a variety of methods to resist viral infection. When human cells detect an invading virus, a series of cellular "alarms" attempt to stop the infection by shutting down cellular functions essential to the virus. While human cells use proteins as the chief defense against viruses, they also encode short RNA strands called microRNAs to regulate the cell's overall health.

Dr. tenOever discovered that the natural microRNA pathway could

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The U.S. Army Research Office

The U.S. Army Research Office (ARO) is a part of the U.S. Army Research Laboratory (ARL), which is the nation's premiere laboratory for land forces. ARO has an extensive track record for directing fundamental research to provide the foundation for next-generation Army biomedical, engineering, communications, sensing and energy applications. As the Army's principal extramural basic research agency, ARO drives scientific discoveries that will provide the Army with significant advances in operational capabilities through high-risk, high pay-off research opportunities, primarily with universities, but also with large and small businesses.

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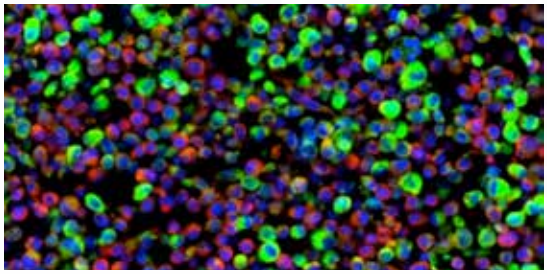
be exploited to regulate viral growth by introducing short RNA sequences that interact directly with a pathogen's genes. He then demonstrated a method for delivering synthetic microRNAs to specific types of cells.[1-7,10-11] These microRNAs are harmless to humans, but provide a significant resistance to viral growth and may allow a human's natural immune system to eliminate an infection before symptoms develop.

In the long term, these discoveries may hold the key to winning an important battle in the genetic arms race of human versus pathogen. However, several key challenges remain before these methods can be tested in the field. Future work must determine whether these discoveries are adaptable for different types of viruses, and the safety and efficacy of these methods must also be demonstrated through rigorous laboratory and clinical studies.

These successes highlight the unique role of ARO in driving high-risk basic research in directions relevant to the Army and DoD. ARO brought Dr. tenOever's discoveries to the attention of DARPA, which recognized the potential of this research and is now funding Dr. tenOever's laboratory to pursue future anti-viral therapies. In addition, scientists at the U.S. Army Medical Research and Materiel Command (MRMC) are interested in transitioning his discoveries to explore new mechanisms to rapidly protect the Warfighter from new viral threats.



Abundant microRNA in Virus-infected Cells. Virus infected cells labeled with RNA to depict the nucleus (blue), the cytoplasm (red) and viral production of RNA (green).

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Promoting Coordination, Collaboration, and Communication

One of the top priorities of the HPT&B Directorate is to promote coordination, collaboration, and communication within the DoD, between the DoD and other Federal agencies, with the civilian community, and in the international arena. The following highlights recent HPT&B outreach activities.

Building Joint Autonomous Patient Transport Capabilities

By Dr. Brandon Martin

On August 12-13, 2014, HPT&B hosted a DoD workshop to discuss strategies to develop autonomous, unmanned and optionally manned systems for tactical combat casualty care, extraction, and transport. Autonomous systems can provide a significant leap forward for medical personnel to more safely and effectively manage the complex challenges of patient treatment and transport during combat. The success of the workshop stemmed from the collaboration of representatives from 5 COIs (ASBREM, Human Systems, Autonomy, Air Platform, and Ground/Sea Platform) in addition to relevant Service members involved in casualty evacuation operations.

A workshop panel reviewed broad scenarios and concepts of operation for the use of a combination of manned/unmanned systems and assisted/unassisted medical care from the point-of-injury (POI) of a Warfighter on the battlefield to treatment in an OCONUS or CONUS medical facility. Each stage of care and each transition and transport between these stages presents challenges and opportunities for the use of autonomous systems. Using this framework, participants discussed issues of safe and stable transport of patients using autonomous systems, control mechanisms and reliability of autonomous systems, design considerations and capabilities of air, ground, and sea platforms, and current state-of-the-art of autonomous closed-loop medical systems.

Participants in panel discussions and break-out meetings identified some key challenges involved in integrating autonomous systems effectively across the Services that have diverse missions and platforms. These challenges include the development of metrics to evaluate the efficacy of unmanned systems and to promote trust in those systems, the assurance of cybersecurity, standardization of mission-independent interface and control systems across platforms, and the development of specific concepts of operation for autonomous system use that can serve as the basis for strategic planning of future R&D.

Biomechanical Modeling and Simulation Across the DoD

By Ms. Jennifer Coughlin

Biomechanical modeling and simulation tools have the potential to accelerate development, improve cost effectiveness, and improve performance capabilities of exoskeletons and other biomechanical assist devices such as prosthetics. Breaking the design-build-test-redesign paradigm, which is both cumbersome and costly, requires better modeling and simulation tools to both shorten the development cycle and to better link exoskeleton properties with overall human performance for the task and environment of interest (lifting, walking, climbing). New computational models and simulation tools could provide an important understanding and ability to optimize the design, synthesis and fabrication processes of biomechanical assist technologies. DoD has invested in several efforts to develop biomechanical models for specific DoD applications such as exoskeletons, prosthetics, and ship/aircraft maintenance. At the same time, industries, such as the automobile, athletic gear, and athletic

Simulation of Warfighter Bearing Load

performance industries, recognize the importance of biomechanical models and simulation tools and are internally supporting development of these tools to assist with the design and evaluation of their products.

HPT&B sees the cross-cutting implications of the biomechanical modeling and simulation tools and has a desire to enhance coordination and collaboration in this area, as well as develop a long term strategy for R&D investment. The United States Special Operations Command, Joint Acquisition Task Force Tactical Assault Light Operator Suit (USSOCOM JATF TALOS) has specific biomechanical modeling and simulation needs and time constraints associated with the delivery of TALOS in 2018. Together, the HPT&B and SOCOM have a common interest in understanding the state of the art in biomechanical modeling and simulation and moving the development of these tools forward in a meaningful way. Working together, OSD and SOCOM held a Joint Biomechanical Modeling and Simulation Workshop on August 28-29, 2014 in Arlington, Virginia. The workshop brought together four different groups critical to provide insight into strategies for short term and long term development, validation, and use of biomechanical modeling and simulation tools. Representatives from the following four groups were present at the workshop:

- Biomechanical Assist Technology/ Device User Community- DoD representatives with clear needs for biomechanical models and simulation tools

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Biomechanical Modeling and Simulation Across the DoD

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- Biomechanical Modeling and Simulation Community - active researchers from industry, academia, and government in the area of biomechanical modeling and simulation
- Biomechanical Motion Capture/ Analysis/ Experimental Community- representatives from industry, academia, and government with biomechanical motion capture and analysis capabilities
- Exoskeleton Developers – industry and government representatives developing or with the potential to develop exoskeleton type of devices

Representatives from each of the various communities were given time to brief the group on their needs, capabilities, challenges, and programmatics (funding, sponsors, technology readiness). Based on these presentations, the entire group engaged in two interactive panels designed to cross-walk biomechanical modeling and simulation capabilities with short and long term DoD needs. During the first panel, SOCOM and exoskeleton developers provided feedback to the modeling and simulation community, as well as biomechanical motion capture/analysis community on what they needed. The modeling and simulation community and biomechanical motion capture/ analysis community discussed how their capabilities might meet those needs. During the second panel, DoD program managers and user representatives, discussed the following points:

- Identifying Key Technical Challenges (Modeling/Simulation)
- Other Challenges –Cost/ Schedule/Performance (Modeling/Simulation)
- Moving Towards Rapid & Accurate Development Cycles
  - Ideal inputs/outputs of models
  - Coupling Modeling/ Simulation Community with Experimental Community
  - Facilitating Validation and Verification

From the briefings, panel discussions, and an additional data collection effort, the group produced a "Wish List" which details specific needs or wants from each of the communities from the other three communities. In addition, several broad areas of need were identified in the workshop including:

- Increased communication, collaboration and coordination between the various communities (users, modeling and simulation groups, experimental group, and technology developers)
- Improved problem definition from user community

HPT&B and SOCOM are currently working together to promote progress in the near-term with a potential prize challenge which requires the communities to work together to meet specific, time-sensitive SOCOM needs. In addition, the Human Systems COI is working to take the wish list and gaps identified in the workshop to build a long term R&D strategy in the area of biomechanical modeling. A full workshop report is available upon request.

HPT&B Participates in the Military Health System Research Symposium (MHSRS)

Dr. Patrick Mason, LTC Dawn Fitzhugh, and Dr. Farah Abdulla attended the Military Health System Research Symposium (MHSRS) in Ft. Lauderdale, Florida from 18-21 August 2014. The MHSRS is sponsored by Dr. Jonathan Woodson, the Assistant Secretary of Defense for Health Affairs (ASD(HA)), and is the nation's only scientific meeting focused on the unique medical needs of the Warfighter. Over 1100 briefings and posters were presented at the MHSRS to include briefings from senior leadership on the transformation into the DHA. The topics presented spanned across the entire range of military health care to include medical education and training, psychological health, burn care, infectious diseases, and musculoskeletal injuries. Representatives from the medical communities of Canada, Israel, and Great Britain also participated in this symposium as did representatives from the FDA.

Army Research Laboratory Hosts HPT&B

In March 2014, HPT&B staff members traveled to Aberdeen Proving Ground, MD to visit the Army Research Laboratory's Human Research and Engineering Directorate (ARL-HRED). Following an introduction by Mr. John Lockett, the group toured four different labs across the ARL-HRED directorate. The first stop was the Mission Impact through Neuro-inspired Design (MIND) Laboratory. MIND is an environment designed to accommodate ARL's neuroscience research, providing a space for conducting multiple human research studies in an environment that enables flexible environmental control for scientific experiments.

The team then traveled to the Cognitive Assessment, Simulation, and Engineering Laboratory (CASEL), where they were able to experience the immersive simulator used to explore warfighters' cognitive readiness and knowledge management in stressful, militarily relevant conditions. The team then discussed HRED's projects in Human Robotic Interaction before touring the Soldier Performance and Equipment Advanced Research (SPEAR) laboratory, where they learned about the research, development, and testing of human augmentation devices.

Dr. Fred Pearce, former HPT&B associate director for biomedical research, receives a demonstration of brain- machine interaction technology being developed at ARL MIND

Indo-U.S. Scientific Workshops

In 2013, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) and the Principle Deputy Assistant Secretary of Defense, Research and Engineering (PD ASD(R&E)) visited the Indian Defence Research and Development Organization (DRDO) in support of the Defense Trade and Technology Initiative (DTTI). Discussions at this visit identified the need for focused scientific workshops between the two countries. The first of these workshops were the Indo-U.S. Workshop on Cognitive Sciences/ Autonomy and the Workshop on Directed Energy and Biological Exposure, which took place in New Delhi from 8-10 September, 2014. An HPT&B-led delegation of thirty one DoD researchers participated in these workshops.

The Cognitive Sciences/Autonomy workshop focused on the research and development that lies at the intersection between cognitive science and autonomy including developing control solutions for autonomous systems modeled after human cognitive processes (cognitive architectures). Discussions also focused on applications for these architectures including human-machine teaming and adaptive human-machine interfaces.

Some of the attendees to Indo-U.S. Scientific Workshops on Cognitive Sciences/Autonomy and Directed Energy/Bioeffects

Additional briefings from both delegations focused on challenges and opportunities with developing autonomously behaving robots, whose behaviors with human operators are modeled after human-social interactions.

During the Directed Energy workshop, DRDO scientists from seven different labs provided briefings on numerous aspects of Directed Energy research to include atmospheric propagation, adaptive optics, thermal management materials, high power microwaves, and biological effects to exposure from lasers and radio frequency.

Potential collaborative project topics were identified at each workshop. These topics were further reviewed and eleven preliminary project summaries were developed. In the upcoming months, these topics will be further refined and, following approval from leadership and a finalized Research, Development, Test and Evaluation (RDT&E) Agreement, those that receive approval will be further developed into formal Project Agreements (PA).

The potential collaboration topics that have been developed into preliminary project summaries are:

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North Atlantic Treaty Organization (NATO)

In April of 2014, Dr. Patrick Mason was appointed as the U.S. voting principal panel member to the Human Factors and Medicine (HFM) panel within the Collaboration Support Office (CSO) of the Science and Technology Organization (STO) of the North Atlantic Treaty Organization (NATO). Dr. Mason recently traveled to Lithuania to represent the U.S. at the 34th HFM panel business meeting to discuss ongoing NATO activities, propose new HFM activities, and steer the technical direction of the panel. The HFM is comprised of 50 NATO and non-NATO nations and provides the scientific basis for establishing an operationally fit and healthy force, restoring health, minimizing disease and injury, optimizing human protection, sustainability and survivability. HFM areas of interest include, among others, medical diagnosis, prevention, treatment and evacuation. HFM also focuses on enhancing human protection research on physiological and physical influences, e.g. of cold, heat, air pressure, noise, vibration, ionizing and non-ionizing radiation, acceleration, motion, biological and chemical effects on the human body, and developing appropriate countermeasures. For more information on the NATO HFM panel please visit the following website: http://www.cso.nato.int/panel.asp?panel=2.

The Technical Cooperation Program (TTCP)

TTCP is a five-nation cooperative arrangement between the United States, Great Britain, Canada, Australia, and New Zealand. There are 11 S&T groups within TTCP. Dr. Mason is the U.S. National Representative to the Human Resources and Performance (HUM) Group. The five TTCP HUM National Representatives and their Technical Advisors, as well as the UK representatives for each of the seven HUM Technical Panels came together for the 2014 HUM Annual meeting in Portsmouth, UK in June of this year. For more information on TTCP please visit the following website: http://www.acq.osd.mil/ttcp/.

Indo-U.S. Scientific Workshops

Continued from previous page

1. High Altitude Fatigue Management & Performance Sustainment
2. Cognitive Tools for Target Detection System
3. Experimental & Computational Studies of Blast & Blunt Traumatic Brain Injury
4. Improving Cognitive & Artificial Cognition Models
5. Small Intelligent Autonomous System for Situational Awareness
6. Atmospheric Propagation of High Energy Lasers
7. Bio-Effects of Laser & High-Power Microwave Sources
8. Advanced Cathode Research for Directed Energy / Accelerator Sciences Applications
9. Flux Compression Generator Based Explosive Pulsed Power Source
10. Testing, Evaluation, Verification, and Validation (TEVV) for Autonomous Systems
11. Joint Sealed Microwave Source Co-Development

Following these two workshops, six U.S. Delegates traveled to Mysore to meet with senior leadership and researchers at the Defence Food Research Laboratory (DFRL). This laboratory complements the U.S. Combat Feeding Research and Engineering Program that is responsible for the research, development, and engineering of all aspects of combat rations, from nutrient incorporation and mission specific nutrient and caloric needs, to packaging and preparation of the rations.

COMMUNITY SPOTLIGHT

The DEKA Arm: Collaborating to Build Prosthetic Capabilities

Photo courtesy of DARPA

The DEKA Arm System is capable of handling objects as delicate as grapes and eggs and also manipulating power tools, such as a hand drill

In May 2014, the Food and Drug Administration (FDA) approved the DEKA arm system, an advanced electromechanical prosthetic upper limb that can perform multiple, simultaneous powered movements using a variety of novel inputs. The combination of these inputs- such as electrical signals from contraction of muscles near the prosthetic interface, wireless signals generated by innovative sensors on the user's feet, and force sensors in the prosthetic hand- provide the DEKA arm system with capabilities to perform more complex tasks similar to capabilities of a natural arm. In addition, researchers leveraged recent technology breakthroughs in the miniaturization of parts for motors, computer controls and sensors, and manufacturing processes with lightweight, but strong materials to keep the size and weight of the system closer to that of a natural arm.

Support for the development of the DEKA Arm was initiated under DARPA's Revolutionizing Prosthetics Program which commenced in 2006. However, DARPA reached out to a number of federal agencies to leverage expertise, funding, and access to data. The FDA reviewed information from a Department of Veterans Affairs-funded Optimization Study, which included data from 36 participants. The United States Army Medical Research and Materiel Command provided funding assistance to enable completion of tests and trials required to meet FDA requirements. The U.S. Army Research Office provided contract management support.

As reported on the DARPA website - "Interagency collaboration has been critical to the Revolutionizing Prosthetics program to allow for independent assessments of the technology, incorporation of user feedback into the design, and identification of regulatory strategies and transition paths," said Dr. Justin Sanchez, the current program manager. "We could not have achieved our goal so quickly without the support of many partners in government."

For more information on the DARPA Revolutionizing Prosthetics Program visit http://www.darpa.mil/Our_Work/

The People of HPT&B

The HPT&B portfolio encompasses a diverse range of research and academic disciplines executed throughout the many arms of the DoD. It is no surprise then, that in order to successfully provide the technical leadership and oversight of the HPT&B portfolio, the people of HPT&B possess varied expertise, backgrounds and experience. HPT&B staff members may consist of detailees from the Services eager to offer their specific Service perspectives while gaining a DoD wide understanding of core competencies and research capabilities. American Association for the Advancement of Science (AAAS) Science and Technology Policy Fellows may rotate through the HPT&B office contributing their specific expertise and analytical skills while learning first-hand about S&T policy making and implementation. Neuroscientists, Aerospace Experimental Psychologists, Veterinarians, Dermatologists, Biochemists, Biophysicists, Polymer Scientists, and Civil Engineers; the HPT&B Directorate has seen them all.

Just as the HPT&B research priorities emerge and change, so do the people of HPT&B. Below are some important announcements and staff arrivals and departures.

Announcements

Commander Joseph Cohn (PhD, Neuroscience) has been appointed as the Deputy Director of the HPT&B Directorate. CDR Cohn, an Aerospace Experimental Psychologist (AEP) in the U.S. Navy's Medical Service was previously assigned to HPT&B as the Associate Director of Training Research and the Associate Director of the Human Research, Development, Testing and Evaluation Protection Program. During his previous tour, he served in the Office of Naval Research's (ONR) Human and Bioengineered Systems Division, as a Military Deputy and Program Officer. He also served as ONR's first Deputy Director of Research, for Science, Technology, Engineering and Mathematics (DDoR - STEM).

Arrivals

Dr. Brandon Martin joins HPT&B as a new AAAS Science & Technology Policy Fellow. Within the HPT&B Directorate he will be focused on medical, neuroscience, and international S&T activities. He earned a Ph.D. in Neuroscience from Georgetown University and completed a joint postdoctoral fellowship at Children's National Medical Center (Washington, D.C.) and SAGE Therapeutics (Cambridge, MA). His work focused primarily on the neurophysiology of anxiety and epilepsy and the development of novel pharmacological treatments for these disorders. Additionally, prior to graduate training, Brandon served for two years as an emergency medical technician in Charlottesville, VA.

Dr. David Simon joins HPT&B as contract support staff and as an expert in the field of immunology and vaccine development. He earned his Ph.D. in Immunology from the University of Rochester and completed a postdoctoral fellowship at the National Institutes of Health within the field of virology. Dr.

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QUICK FACTS

on DoD's Human Subject Research Portfolio

The Department of the Army has the third largest human subject research portfolio in the Federal Government behind National Institute of Health (NIH) and the Food and Drug Administration (FDA).

The Department of Defense has 52 internal Institutional Review Boards (IRBs) and 146 sites which conduct intramural research involving human subjects.

The People of HPT&B

Continued from previous page

Simon joined the support staff at the directorate after supporting DARPA as a Science and Engineering Technical Assistant (SETA) for over three years. His work at DARPA included supporting multiple programs, seedlings, and projects.

Departures

Sadly, Mr. Robert L. Boyd, the Associate Director for Sustainability and Environmental Sciences Research in HPT&B, passed away on June 11, 2014. Mr. Boyd made significant and lasting contributions to HPT&B from April 1995 through June 2014. He served as the Defense Department's leading advisor and staff specialist for sustainability and environmental sciences. He provided strategic planning, coordination, and oversight for these programs within the Defense Department. He provided oversight of the Strategic Environmental Research and Development Program (SERDP), Chemical and Biological Defense research program, and the Logistics research program. He also served as the interface between the OASD(R&E) and the Deployed Warfighter Protection Program of the Armed Forces Pest Management Board. Mr. Boyd spearheaded the coordination of Defense programs and policies across the Federal family including on the White House's National Science and Technology Council and its Committee on Environment, Natural Resources and Sustainability (CENRS) and served as Executive Secretary on the CENRS Subcommittee for Toxics and Risk. He was recognized across the Federal government as the DoD focal point for interagency coordination on public health, environmental, and safety research programs.

Mr. Boyd's outstanding accomplishments and leadership in the course of his twenty seven year career within the Department of Defense (DoD) contributed significantly to defense science and technology (S&T), and acquisition. Bob is survived by his wife Nancy of twenty six years and their four children.

Dr. Farah Abdulla, MD, HPT&B's recent S&T Policy Fellow with AAAS Directorate has taken a position with the University of Chicago, Department of Dermatology, Section of Dermatology. She will be heading their cutaneous lymphoma clinic in which she will care for patients as well as pursue translational research. She will also be working with the South Side Collaborative in an effort to extend dermatologic and oncologic care to the underserved. While at HPT&B over the past year, Dr. Abdulla focused on identifying areas in DoD's medical R&D portfolio that could benefit from improved coordination and collaboration. She worked as part of a team encouraging collaborations in the area of cognitive science between the Singapore's Ministry of Defense and the DoD. She made great strides towards building a Joint Autonomous Patient Transport Capability. She spearheaded the effort to bring together representatives from five different COIs (ASBREM, Human Systems, Autonomy, Air Platform, and Ground/Sea Platform) in addition to relevant Service members involved in casualty evacuation operations, to identify gaps and challenges that need to be addressed to move the concept of autonomous patient transport forward.

Upcoming Activities, Conferences, and Workshops

S&T for Blended Adaptive Language & Culture Training Symposium

When: Spring 2015

Where: Strategic Analysis, Inc. Executive Conference Center Arlington, VA

POC: Hannah Freeman hfreeman@sainc.com or Hannah.I.freeman7.ctr@mail.mil and CDR Joseph Cohn joseph.v.cohn.mil@mail.mil

What: In an increasingly interconnected world, maintaining our Nation's global security interests requires a military force that is able to successfully communicate and interact with a wide range of cultures – in their native language. Yet, according to a recent Report to Congress on Foreign Language Proficiency, the Department of Defense (DoD), is able to fill less than 30% of its ~41,000 language-coded billets with personnel having the required proficiency in the language specified for the billet. The DoD currently addresses this challenge in three ways: by supporting foreign language and culture education, across grades K-16; by providing initial language and culture acquisition training following recruitment and accession; and, by offering sustainment/ enhancement training to maintain and extend these skills. Currently, digital training tools, like online portals or websites, are used to deliver a portion of this training. To be maximally effective these digital resources should not only be blended with existing classroom instruction, but should also adapt their training to each student's learning style and guide students to specific resources to maintain or improve their language skills.

Following extensive discussions with the Defense Language & National Security Education Office (DLNSEO) – which leads the nation in recruiting, training, sustaining, and enhancing language and culture capabilities to ensure national security and defense readiness – the decision was made to hold a symposium on the challenge of developing adaptive language & culture training technologies and integrating them into the classroom environment. The "S&T for Blended Adaptive Language & Culture Training Symposium" will be jointly hosted by OASD(R&E), under the auspices of the Human Systems Community of Interest (COI), and DLNSEO and will be held in Spring 2015 at the Executive Conference Center (4075 Wilson Boulevard, Suite 300, Arlington, VA 22203). The Symposium will replace the previously reported "Individualized Training for Accelerating Expertise Development Workshop" (*HPT&B Newsletter* 2 June 2014). The goals of the Symposium include:

- Understanding the S&T challenges and opportunities associated with creating better, more effective blended and adaptive foreign language and culture training in more efficient ways to maximize the return on training investment.
- Providing the scientific foundation for developing science and technology programs with identified deliverables and transition customers within DoD and across Federal Agencies.
- Achieving a unified voice within the DoD language training enterprise to clearly articulate future requirements to the DoD's science and technology enterprises.

Attendance at the Symposium is open to government, academia, and industry, but will be limited to 100 participants due to capacity restrictions.

NDIA Human Systems Conference 2015, 'Human Systems: Maintaining our Physical Edge, Enabling our Cognitive Edge'

When: February 10-11, 2015

Where: Alexandria, VA

POC: Hannah Freeman Hannah.I.freeman7.ctr@mail.mil

Website: http://www.ndia.org/meetings/5350/Pages/default.aspx

What: NDIA's annual Human Systems Conference offers a dynamic exchange of technical information and dialogue between government, industry, and academic leaders from the Human Systems Science & Technology community who are interested in advancing the field through education, consultation, future research, and collaboration opportunities.

To ensure our nation's readiness to overcome new and emerging threats

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across both physical and technical infrastructures, there is a critical need for the DoD to focus on optimizing warfighter performance in the decision making and information processing domains, while maintaining and enhancing warfighter performance in the physical domain. Summarizing this dual-focus requirement, Mr. Alan Shaffer (Principal Deputy, ASD(R&E)) stated in February 2014, "It used to be the people who would win the arm wrestling match would win the war […] In the future, it is going to be who can process information most quickly and react […]" Human Systems, with its emphasis on extending, enhancing, sustaining and repairing the capabilities of the military forces, is uniquely positioned to develop technologies which will allow today's warfighter to effectively execute these emerging operational requirements.

The 2015 Human Systems Conference, scheduled for 10-11 February 2015 in Alexandria, VA, will engage leaders in government, academia, and industry to explore how the Human Systems community can directly support the development of new technologies to provide a cognitive advantage over our adversaries while continuing to support our forces' physical readiness.

The Conference will feature brief, high-impact presentations of technical accomplishments and research based recommendations in five, 90-minute blocks across Topic Areas. These will include the Department of Defense recognized Human Systems Community of Interest Topic Areas: Systems Interface and Cognitive Processing (SI&CP), Protection, Sustainment and Physical Performance (PS&PP), Personnel, Training and Leadership Development (PTLD), and Social, Cultural Behavioral Understanding (SCBU). Additionally, based on feedback from conference attendees, a fifth Topic Area will be explored: Human Systems Integration (HSI) Metrics.

Human Factors Engineering Technical Advisory Group (HFE-TAG) Meeting- TAG 69

When: May 5-9, 2015

Where: NSA Orlando, FL

Website: http://www.acq.osd.mil/rd/hptb/hfetag/

What: The 2015 DoD Human Factors Engineering Technical Advisory Group meeting (TAG 69) will be held at NSA Orlando from 5-9 May, 2015. The HFE TAG is composed of over 300 HFE practitioners and researchers from across the DoD, DHS, FAA and NASA, along with representatives of technical societies and industry. There will be a New Member meeting and an Executive Committee meeting held on Monday, 5 May. Each of the SubTAGs (Cognitive Readiness ; Controls and Displays; Design: Tools and Techniques; Extreme Environments; HFE-HSI-M&A; Human Modeling & Simulation; Human Performance Measurement; Personnel Selection & Class; Standardization; Systems Safety, Health Hazards, Survivability; Technical Society-Industry; Training; Unmanned Systems; User-Computer Interaction subareas) will hold sessions throughout the week and the meeting will close with an Operating Board meeting on Thursday, 8 May.

Editor Ms. Jennifer Coughlin, Strategic Analysis, Inc.

Layout and Design Ms. Amy Cauffman, Strategic Analysis, Inc.

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