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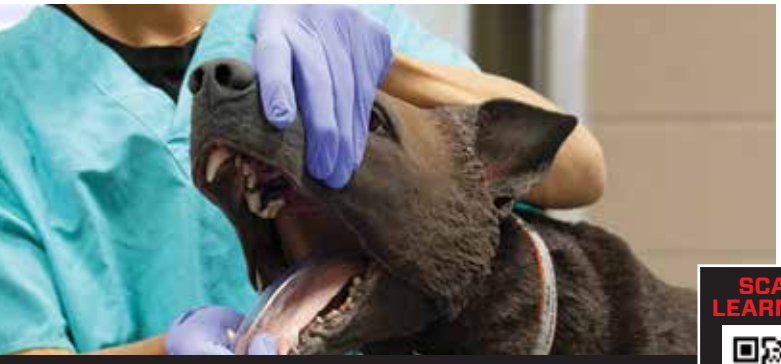

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POLYTRAUMA: ADDRESSING MULTIPLE THREATS SEAMLESSLY

As the U.S. Army continues its assessment of future multi-domain battlefield operations, addressing plural trauma combat medicine has become – as part of necessity – an increasingly important part of that conversation.

By Ramin A. Khalili

Features

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DELIVERING MISSION-READY SOLUTIONS

BG Edward H. Bailey
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MEDICAL SOLUTIONS ROUNDTABLE

GAINING GROUND ON A FUTURE ARMY

COL Jeremy Pamplin
Commander, TATRC

COL Chad Koening
Commander, WRAIR

Dr. Kendra Lawrence
WPAC PMO

LEADERSHIP PERSPECTIVE

PROMOTING HEALTH READINESS

Dr. Lester Martinez-López
Assistant Secretary of Defense for Health Affairs

Cover: U.S. Army Combat Medics with the 1-114th Infantry Regiment, 44th Infantry Brigade Combat Team train with a Trauma F/X patient simulator during training on Joint Base McGuire-Dix-Lakehurst, New Jersey. (U.S. Air National Guard photo by Master Sgt. Matt Hecht)

Departments

CLOSING THE GAP BETWEEN VIRTUAL AND REALTIME
The Defense Health Agency is promoting advances in medical simulation to help prepare for the future of military medical care.
By Terry J. Goodman

SECOND SIGHT: VISION FROM A BRAND NEW PERSPECTIVE
The U.S. Army Research Institute of Environmental Medicine is pushing the augmented reality envelope, integrating information into the medic's world.
By Dr. Gary Zientara

RETHINKING TRADITIONAL TO EMPOWER THE FORCE
The U.S. Army Research Institute for Environmental Medicine is backing biomedical scientific study of the female body to provide feedback aimed at producing higher level combat performance.
By Madison Langweil

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INSIGHTS

As a wise man once said, "One has nothing without one's health." As a wiser man once said, "Without one's health, one is of no help to anyone else." Such is the sense of responsibility instilled in U.S. Servicemembers of all ranks as they grow under the ethos that each is only as valuable to their fellow comrade in arms as their own health is to themselves. The August 2023 Military Health System Research Symposium (MHSRS) edition of *Combat & Casualty Care* sheds light on advances in both real world and virtually-created medical scenarios where those tasked to restore health serve as a prime example that health of the force equals strength of the force and, just as goals are prioritized for mission success, individual health remains mission priority one.

In the Summer issue of *C&CC*, we dive right in, shining a white-hot spotlight on the art of polytrauma care and ways U.S. Army Medical Research and Development Command (USAMRDC), Ft. Detrick, MD, is leading efforts to deliver field solutions in support of combat medicine within a future multi-domain operations environment. In speaking with new USAMRDC and Ft. Detrick Commanding General, BG Edward Bailey, readers get a look at some efforts the Army's leading medical research command has undertaken to advance the Joint Force mission from a field and combat medicine support vantage. From the top, we drill down into components of USAMRDC and look also to U.S. Army Medical Materiel Development Activity (USAMMDA) for a special roundtable question and answer concerning focus on extension of the critical "Golden Hour" from point of injury to technologies that will enable future medical readiness regardless of treatment on land, sea, or in the air.

From real world to simulated real world, what is distinguishable between actual casualty care and virtual or mannikin-based trauma care continues to diminish. Folks at the Defense Health Agency, in coordination with the Defense Medical Readiness Training Institute (DMRTI), are leading the charge in promoting advances in medical simulation as an important layer in combat medic preparedness. Mr. Joe Ruisi, Deputy Chief and Administrator, Medical Modernization Division, Air Force Medical Modeling and Simulation Training Program (AFMMAST) tells *C&CC* readers, "Models and simulations lead to improved decision-making, better surgical outcomes, and enhanced patient safety." By patient safety, Ruisi means that lives can be put at risk during treatment as much as by trauma itself. Simulations allow for practice of complex procedures, such as surgeries or emergency interventions, allow with zero chance of danger to casualty. Of course, the only true test of simulation's worth is when practice goes live and patients still survive.

Until now, medics working mannikin training could only surmise internal injury, however, with the latest in multi-color, virtual visualization, internal trauma can now be viewed along with the expression of trauma treatment. The U.S. Army Research Institute of Environmental Medicine (USARIEM) is employing an augmented reality (AR) tool, used in conjunction with field casualty care, that provides combat medics with real-time visuals inside a wounded casualty. An AR-enabled future will ensure that medics never see casualties the same way.

As always, we welcome any comments or suggestions. Thanks for your continued readership!

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POLYTRAUMA: ADDRESSING MULTIPLE THREATS SEAMLESSLY

As the U.S. Army continues its assessment of future multi-domain battlefield operations, addressing plural trauma combat medicine has become an increasingly important part of that conversation.

By Ramin A. Khalili, U.S. Army Medical Research and Development Command

A team of USAMRICD scientists takes part in a video shoot designed to teach participants in the Medical Management of Chemical and Biological Casualties course how to successfully perform key tasks associated with casualty care. (Stephanie Froberg, USAMRICD)

The future battlefield will look markedly different than what the military has experienced in the past, especially when factoring in the increasing lethality of weaponry and the changing nature of warfare itself. The consequences of such change, which will likely include a sharp increase in polytrauma injuries, is a key driver of the research currently being performed at the U.S. Army Medical Research and Development Command's Medical Research of Institute of Chemical Defense (USAMRICD).

Shane Kasten

"Polytrauma is a fancy word for combined injuries," explains Shane Kasten, director of research at USAMRICD. "For instance, a blast trauma might involve both a concussion – or even a traumatic brain injury – and a wound from shrapnel. At the same time, it's possible the shrapnel was contaminated with a chemical agent, which might contaminate the wound – which, in turn, results in a chemical exposure."

NEW TRAUMA BAY LAB ON MISSION

To offset the potential impact of such injuries, USAMRICD has launched an aggressive slate of projects in recent years, with several of those efforts coming to fruition in the past few months. A total of five such research and development projects, all funded by USAMRDC's Combat Casualty Care Research Program, have been initiated since 2021, with three of those focusing exclusively on polytrauma models – or, situations that involve dual treatment of both physical trauma and chemical agent exposure in the same casualty.

The newest of these projects, initiated in June, is a surety trauma bay laboratory that will allow the replication, testing and evaluation of specific polytrauma injuries that involve exposure to chemical warfare agents. For perspective, a surety trauma bay laboratory is distinguished

from other trauma bay models in that it allows scientists to safely work with highly toxic chemical warfare agents. This type of combat injury research capability – notably referred to as a "dual threat" capability – is being developed as part of a collaboration with Vik Bebarta and his team at the University of Colorado (UC) Anschutz Medical Campus. The eventual outcome of this effort will include a 714 square foot, dedicated suite at USAMRICD to house and enable such work. The overarching purpose of the collaboration with UC is to develop a translational, combat-relevant model that will support the research and optimization of current polytrauma treatments, ultimately informing overall medical management of combined injury casualties.

James Dillman

Once controlled polytrauma can be reliably reproduced, multiple physiological measurements can be recorded along with periodic blood sampling. Biomarkers will be identified through evaluation of various biochemical outcomes (such as coagulopathy, blood chemistry and metabolic acidosis) to better understand the relationship between treatment and indicators of survivability. This model will be critical to the optimization of treatment strategies for combined injuries and for the development of new clinical practice guidelines based on the research outcomes. Since morbidity and mortality data for these types of injuries are unknown at this time, scientists do not have a full picture for wartime planning and contingency operations; both, however, must eventually include survival translation models, along with a better understanding of complex chemical warfare agent exposure and trauma injuries. These in turn require the kind of systematic evaluation that only tools such as the surety trauma bay laboratory can provide.

"We have always known that chemical exposure was likely to happen in the context of other battlefield injuries, and so this effort is a natural progression of research to bring the best treatment strategies to the field," says USAMRICD chief science officer James Dillman, who has more than 23 years of experience at the laboratory. "We think we know how we should treat these types of combined injuries and we need data to support evidence-based approaches to treatment. This research effort will help provide the data and the resulting evidence to support the most effective clinical practice guidelines."

ADVANCING WOUND DAMAGE MITIGATION

Another exciting project at USAMRICD involves the development and validation of a combined injury model for battlefield wounds and dermal burns contaminated with chemical agents; specifically, a nerve or blister agent. The primary objective of this project is developing a robust and reliable polytrauma model that can underpin advances in medical doctrine for the treatment of chemically contaminated wounds while also providing a framework for assessing current and future medical products. This project, currently under the direction of Bryan McCranor, a research biochemist in USAMRICD's Pharmaceutical

Sciences Department in the Medical Toxicology Research Division, aims to understand how blister agents exacerbate damage in wounds and burns while also giving insight into adverse impacts on the healing process. Additional ongoing studies at USAMRICD involve the assessment of current medical countermeasure and decontamination products to better understand how current treatment modalities can provide an improved outcome on the battlefield. Such an effort runs adjacent to the Army's continuing commitment to prolonged care on the future battlefield; the combination of advanced weaponry being used in new and different battlespaces likely requiring point-of-injury casualty care for, potentially, two-to-three days.

COL Paul Kassebaum

"Treatment in a hospital setting would be ideal, of course, but the logistics of the future battlefield will likely require improved treatment options due to infrequent evacuations of casualties," says Kasten, who has spent the past 15 years at USAMRICD. "Army leadership predicts severely contested airspace on the future battlefield, which will negatively impact ability to rapidly – in, say, one-to-two hours – remove new casualties off the battlefield to higher echelons of medical care."

TARGETING TRAUMATIC BRAIN INJURY AND NERVE AGENT EXPOSURE

A third notable project initiated in 2021 has been conducting polytrauma research with a mouse model combining TBI and nerve agent exposure. While treatments for TBI and nerve agent exposure are already available on an individual basis, the proper way to treat both injuries when experienced concurrently in the same casualty has not been studied to such a degree. What is not known is whether standard treatments for both injuries are compatible and not contraindicated when used in combination, especially during prolonged field care.

In the first phase of this research, Erik Johnson, a research pharmacologist at USAMRICD's Neuroscience Department and the Medical Toxicology Research Division, developed a variable-severity TBI model for nerve agent exposure. This model offers a wealth of information to include neuropathology, seizure dynamics, physiological parameters and innate behavioral responses following a combined injury. Johnson's team has already determined compatibility and effectiveness of standard treatments when using existing treatment guidelines. This project, currently in its third year, has expanded to include the evaluation of alternative drugs already carried by Role 1 medics to further reduce morbidity and mortality without additional logistical burden.

FOCUSING ON ENHANCED PROLONGED FIELD CARE

In the end, a catalyzing factor for proposing this essential research is the need to inform concept of operations documents and treatment procedures carried out by combat medics in the field and by medical providers at higher roles of care. Currently, clinical practice guidelines and Tactical Combat Casualty Care (TCCC) Guidelines do not provide guidance or specific regimens for medics treating combined trauma and chemical exposure at the point-of-injury or in prolonged field care settings. These efforts take place directly alongside attempts to provide new and critical experimental platforms capable of pinpointing the most promising medical treatments for the battlefield when treating both physical trauma and chemical agent exposure.

"This type of infrastructure ensures the Army is ready to respond to the unknown threats of 2030 and 2040," says COL Paul Kassebaum, USAMRICD commander, noting the critical nature of his laboratory's work – to include the larger command's work – in the success of the future force. "Updating clinical practice guidelines helps to deliver capability by 2030 with materiel already in the hands of frontline medics and corpsmen. This is particularly critical for future conflicts where we expect prolonged field care to be the norm."

Says Dillman, in closing, "You only need look at recent events across the globe to see that the use of chemical agents is a reality and not simply a theoretical idea in the 21st century. It is critically important for our Warfighters to be prepared to fight in a chemically-contaminated environment in the future – a capability which includes understanding how to protect themselves and how to treat battlefield injuries that involve chemical contamination or exposure. Developing the most effective clinical practice guidelines for treating these injuries will save lives and increase return to duty and support combat power."

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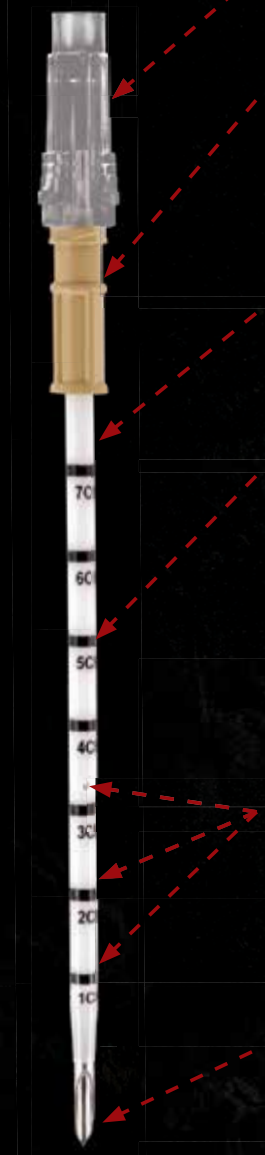

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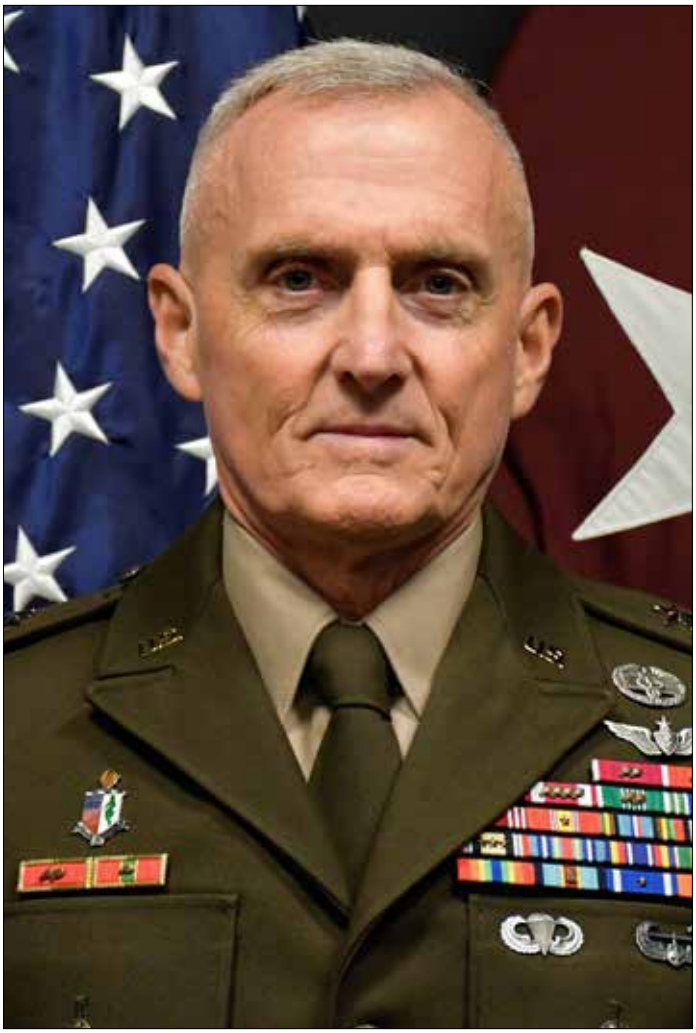
DELIVERING MISSION-READY TREATMENT SOLUTIONS

Brigadier General Edward H. "Ned" Bailey assumed command at U.S. Army Medical Research and Development Command (USAMRDC) and Fort Detrick in late June, following an assignment in Hawaii where he served as both the Commanding General of the Medical Readiness Command, Pacific, and the Deputy Director of the Defense Health Region Agency Indo-Pacific. In his new role, BG Bailey makes a return home of sorts, as he previously attended the University of Maryland, Baltimore County. He commissioned in 1993 and attended the Uniformed Services University, which was followed by an internship and residency in Family Medicine at Womack Army Medical Center at Fort Bragg (known as Fort Liberty since 2023), in North Carolina. Bailey's combat service history includes a deployment to Bosnia-Herzegovina to serve as the flight surgeon for Task Force Med Eagle, as well as a pair of deployments to Afghanistan; first as a battalion surgeon, then as the command surgeon for Regional Command-South. Prior to his assignment in Hawaii, he served as the command surgeon for the U.S. Army Forces Command at Fort Bragg. As he explains here, in one of his first interviews since assuming command, Bailey is eager to step into a position at MRDC that sits at the leading edge of medical technology development. He further embraces the opportunity to have a substantial impact on the health and readiness of U.S. Service Members as the Army moves to meet its modernization goals for 2030, 2040, and beyond.



BG Edward H. Bailey

Commanding General
U.S. Army Medical Research and Development Command & Fort Detrick, MD

Combat & Casualty Care had the opportunity to speak with BG Bailey, Commanding General of USAMRDC and Fort Detrick, regarding his focus on MRDC development opportunities and the latest medical technologies supporting the Army and Joint Force mission.

C&CC: What is your immediate focus upon taking your new role at MRDC?

BG Bailey: Let me start by saying I am extremely proud and excited to be here at MRDC. The history of this command and its recent contributions speak for themselves. Everyone within the Department of Defense and the military community knows the impact that MRDC has made and continues to make on behalf of the Warfighter, so my immediate goal is to get adjusted as quickly as possible. You hear about the pride that the people here – and by that I mean all the Service Members, the researchers and the scientists – take in innovation, in cultivating new ideas, and you can see it immediately when you step foot on the installation. MRDC's mission statement is to create, acquire and ultimately deliver medical solutions to our Warfighters. We want to continue to do that by leveraging our staff, our substantial capabilities and the strength of the joint force.

C&CC: In terms of resiliency, how does MRDC begin to prepare Soldiers for the future battlefield?

BG Bailey: In short, you start by identifying where you need help first. Right now, we're looking at potential holes – we call them gaps – that exist from the perspective of multi-domain operations. The battlefield of the future will be drastically different than what we've seen in recent conflicts and will likely take place in a wide variety of different locations, too: urban areas, austere landscapes – then there's maritime, space and cyber domains as well. So, you start from a medical standpoint – what does the Warfighter need in these domains specifically? We anticipate we're going to see larger amounts of casualties on the future battlefield – probably more than we've experienced in any of our conflicts over the past two decades. Because of the variety of battlefield locations, we're going to see much longer evacuation times as well, which is in turn going to impact our evacuation capabilities – so the concept of force protection plays into this equation as well. Specifically, we're looking at how we provide virtual health support from the point-of-injury to pre-hospitalization evacuation and, ultimately, to a military treatment

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facility. All these things are general themes running through our work.

C&CC: That places an even greater premium on prolonged care on the battlefield moving forward, correct?

BG Bailey: That is correct. In some of these future battlefield locations, we're going to be required to provide medical care for a casualty for a much longer time frame than in previous conflicts; it might be upwards of two-to-three days in some instances before we can move a given casualty back to a Role 3 or Role 4 facility. We will likely not have the kind of air superiority we've enjoyed in the past, so we're going to have to sustain a casualty for much longer than we have previously considered. You have heard about the "Golden Hour," which is that critical period where a casualty needs to receive lifesaving care – well, we are looking to build out that window, to push the limits. How can we help our medical care providers on the ground, in combat arenas, perform these tasks? We do that by looking at things like medical robotics and autonomous systems, even artificial intelligence. These are the tools that will help us expand that "Golden Hour" dramatically.

An MRDC Soldier receives help tending to a casualty from a robotic dog as part of a "Medic-Robot Teaming" exercise during the USAMRDC Capability Days 2023 event at Fort Detrick. Honing this type of technology is a top goal for MRDC moving forward. (USAMRDC Public Affairs)

C&CC: How do you pull all those pieces together, then? How important are communication protocols in this larger plan moving forward?

BG Bailey: Communication will be integral – it always is. We touched on this concept earlier: how do we manage patient regulation, and how do we process a casualty from the point-of-injury all the way through other roles of care? Additionally, how do we manage that casualty and know exactly where they're at and what kind of treatment they've received at those different echelons? That's the challenge in front of us. It's much more than just having visibility of which medical capabilities that are in what theater, and where the evacuation platforms are located. We need to have the right tools and technologies in the right locations at the right time. That's a substantial issue when we talk about operating in more challenging domains, like the Arctic. For instance, how do we train our medics to treat casualties in that environment while ensuring that they don't become a casualty as well? What about our equipment? Can our tools operate in that environment? We've already spent a substantial amount of time looking into that, taking medical equipment up to Ft. Wainwright, Alaska, to test operability in below-freezing temperatures. These are all critical questions we need to answer – not just for the Arctic theater, but for each of those environments as well.

C&CC: When we talk about the Army's goals for 2030, 2040 and beyond, we hear the terms "modernization" and "transformation" used quite a bit. What is the difference between the two, and how do each impact the Warfighter?

BG Bailey: When we talk about modernization, I think of giving the medic a better piece of equipment to help them perform their job better. When we talk about transformation, that means we're trying to get the Service Member ready for a new and different landscape. That means we must train that person better, or maybe it means we must train that person differently altogether. Transformation can also include an organizational type of change as well. These concepts are critical moving forward. We're meeting our requirements through research, development and acquisition – and we're doing it through doctrine and training too. For example, right now, the Army is already changing the instruction that 68 Whiskeys are receiving, placing a greater focus on the sustainment of care than previous medics might recognize. We often think that improvement is simply better or smaller or more rugged equipment– equipment that can absorb the fight – but it also consists of structuring your organization in a way that will ultimately benefit our Service Members.

C&CC: Lastly, what are your other focus points? What other areas are you looking forward to delving into during your assignment at MRDC?

BG Bailey: Biological threats are a big one. What does the next pandemic look like? When it comes to COVID-19, many people think the federal government launched Operation Warp Speed and then, suddenly, vaccines became available. That's not the case. It took years and years of work prior to the pandemic to get to the point where the federal apparatus was able to deliver that kind of solution, and so quickly at that. From our perspective, MRDC must continue investing where we think the next threat might be – because the next pandemic is out there. It's just a matter of when.

Blood and blood products are also a major focus for me, as is the management of blood. MRDC is working on variety of projects right now concerning the storage of blood and, also, increasing the lifespan of blood products on the battlefield. We might not be that far from having synthetic, or even semi-synthetic, blood on the battlefield soon.

All of this is a heavy lift for sure, but I come back to the concept of innovation and how important that concept is to the people at MRDC. You hear about the Army of 2030 and 2040 and you think those dates exist far into the future, but that time frame is truly not that far off. To get where we want to be it will take leveraging the power of the Joint Force and employing our partnerships in the corporate and academic sectors. That's why I'm so eager to step into a role where I can help facilitate these changes for the benefit of our Service Members and the entire Joint Force.

GAINING GROUND ON A FUTURE ARMY

Members of leadership and top scientists from the U. S. Army Medical Research and Development Command (USAMRDC) spoke to Combat & Casualty Care about the new initiatives and technologies in the pipeline at their organizations, while also discussing key concepts related to potential expansion of the "Golden Hour" and the planned transformation for the Force of 2030 and beyond.

COL Jeremy Pamplin

Commander, USAMRDC Telemedicine and Advanced Technology Research Center (TATRC)

COL Chad Koenig

Commander, USAMRDC Walter Reed Army Institute of Research (WRAIR)

Dr. Kendra Lawrence

Warfighter Protection and Acute Care Project Management Office, (WPAC PMO), USAMMDA

C&CC: What are the new technologies, concepts and ideas you're tracking at your respective organizations? Specifically, what are the key initiatives or projects that you are excited about in your organization right now?

COL Koenig: Right now, at WRAIR, we have several efforts underway across all areas of endemic infectious disease and brain health and resilience. The Institute's new cryo-electron microscope is a unique capability within the Department of Defense that will allow researchers to determine the structure of viruses, proteins, antibodies, and drugs in a matter of hours. That is important because this kind of technology has the potential to greatly accelerate structure-based drug and vaccine development. WRAIR's structural biology vaccine expertise is being applied currently in monoclonal antibody development for COVID-19 and HIV, as well as the design of new mRNA vaccines; these include "pan-sarbecovirus" candidates designed to generate immunity across a broad spectrum of coronaviruses. Furthermore, in addition to cutting-edge science of their own, our forward directorates in Thailand, Kenya and the Republic of Georgia are rapidly expanding their networks to provide critical disease surveillance data across the globe. This will help identify emerging threats and inform countermeasure development.

COL Pamplin: It is a busy time. At TATRC, we are taking an all-hands approach to the "Passive Data Collection for Automated Documentation for Casualty Care" – or, as we call it, the "AutoDoc" project. In short, we are trying to address what we see as a fundamental challenge in automating casualty care: capturing the data that describes key aspects of care such as the actions of medics, the state of the patient and the resources used in that process. We aim to do all this passively, without burdening a medic to manually collect this information. The benefit of automated documentation is that it allows for the collection of quality data during casualty care without detracting from the capability and capacity of medics to deliver care. This project will form the foundation of a data collection strategy that relies on multi-modal sensors and the subsequent development of algorithms to analyze and identify aspects of casualty care from that sensor data. To get where we want to go in this regard, we are reshaping our organization from a traditional, division-based structure into functional teams to pursue the development, data collection, coordination, and staff-enabling aspects of this project.

Dr. Lawrence: WPAC PMO has a diverse portfolio of medical solutions that deliver and provide capabilities at all roles of care, including supporting readiness and return to duty as well as prolonged care. Things that I am specifically excited about right now are the various

Extreme environments such as the Arctic pose unique aspects to Soldier and Force resilience. While WRAIR is researching how leader behaviors can reduce suicide risk in Soldiers serving in Arctic environments, USAMMDA is testing freeze-dried plasma products in similar locales. (T. T. Parish, USAMMDA)

prevention and treatment solutions for battlefield wound infections that we are developing. That also includes a variety of canine blood products, a vaccine which would provide inoculation against a specific strain of diarrheal disease and a broad-spectrum snakebite antidote. As many of your readers know, MRDC is preparing for a transition to the Defense Health Agency. As part of this transition, we have a tremendous opportunity to deliver and provide capabilities that support the services and combatant commands in a much greater capacity than ever before by working in this joint enterprise space.

C&CC: How are your organizations preparing for the Army's sprawling 2030 initiative? What is your organization doing to aid the Army's self-described "once-in-a-generation transformation" to develop the capability to converge effects on land, in the air, sea, space and cyberspace?

COL Pamplin: To answer that question I want to go back, in part, to the "AutoDoc" project mentioned previously. To be able to collect data passively from the point-of-injury – and to have that data readily available when needed – that kind of capacity is essential to addressing several other challenges in the automation of casualty care. "AutoDoc" addresses the principal challenge of building trustworthy artificial intelligence in the various environments that we anticipate medics will be delivering casualty care during multi-domain operations. While passive data collection is the foundation of our near-term objectives, our long-term objectives include automating casualty care tasks such as triage, supply distribution, patient tracking, and movement. Artificial intelligence-enabled care will maximize both capability and capacity of the military health care system and mitigate the impacts of massive casualty volumes, thereby allowing commanders to maintain forward momentum during large-scale combat operations.

Dr. Lawrence: To support that kind of transformation, the Army will need Soldiers who are medically ready and able to perform; an effort which includes maintaining operational effectiveness and enabling return to duty, as well as managing prolonged care in contested logistics. That is a full plate. We have been working closely with a diverse array of stakeholders to understand current capability gaps and how they are impacted by new and complex battlespaces. We are looking to industry and academia - in addition to our traditional science and technology partners – to target and identify mature technologies that can address capability gaps and deliver solutions more quickly to meet this initiative.

For example, we have been working with the Armed Services Blood Program and the Office of the Joint Staff Surgeon to better define and understand the need for blood and blood products during multi-domain operations. We are on target to deliver freeze-dried plasma in the next few years, and we are exploring opportunities to expand and increase that capability by scaling up production to meet the projected needs of the Army and the DOD. We are also developing other blood products, such as cold-stored platelets and cryopreserved platelets, to provide

additional capability for hemorrhage control and resuscitation at-or-near the point-of-injury. Cold-stored platelets will extend the shelf life of liquid platelets via refrigeration, which enhances both supply and logistics management and increases the functionality of the platelets. Cryopreserved platelets will enable the DOD to stockpile platelets for use when liquid or CSP supplies are depleted, or when logistics are contested.

COL Koenig: This kind of transformational shift presents a huge opportunity for our forward labs to engage at the combatant command and theater level. WRAIR has been making a concerted effort to synchronize with the combatant commands – especially through the forward labs – so we can better understand emerging force health protection threats and then develop tailored countermeasures. This globally integrated look across an entire theater of operations will be critical in the future operating environment.

Warfighters in 2030 are also likely face new stressors and threats to behavioral health, which could degrade their individual mental wellbeing, resilience, and mission-focused mindset. Our recent efforts suggest that Soldiers whose leaders clearly discuss the purpose of their military service generally report higher states of readiness, lower behavioral health issues and greater unit cohesion. Another area we are looking at for 2030 is austere environments – including the Arctic. We expect to see the emergence of novel pathogens as well as behavioral health challenges, and so we are currently researching how to minimize the impact on cognitive performance and inform interventions to reduce risks such as suicide.

C&CC: A great deal of the Army's focus recently has been on the expansion of the "Golden Hour," that critical window of time in which a casualty needs to be identified and transported back to a higher echelon of care. How is your organization contributing to this effort? More broadly, how does an expansion of the "Golden Hour" – through technology, manpower, etc. – benefit the Warfighter?

COL Koenig: Our disease surveillance efforts across the operational environment predict infection exposure and help us target the right pathogens with new antimicrobial countermeasures, doctrine, policy, and training. Our researchers are also evaluating several tools that can aid injured Soldiers in austere environments for prolonged periods. For example, WRAIR is developing a hemostatic hydrogel that can deliver pain relief – along with either broad or narrow-spectrum antibiotics – when applied directly to a wound. Additionally, our brain health team is optimizing tools to sustain resilience and psychological health to keep our soldiers in the fight. These tools will help expand the "Golden Hour" to a longer period of far forward, prolonged field care. The benefit to the Warfighter is a better chance of returning to duty while still far forward; if evacuation to a higher role of care is needed, that means a greatly increased chance of survival, recovery and return to duty.

COL Pamplin: Expanding capability and capacity both at the point-of-injury and across the system will require automation to help combat medics expand their reach. The availability of data from the point-of-care is essential to understanding what a medic has done – or has not done – in order to provide effective, responsive decision support, inform resource allocation and advise patient movement at the speed of relevance. This data is integral to developing algorithms to automate tasks on the battlefield, such as triage algorithms, which will alleviate the cognitive burden and provide faster triage decision making. This task alone will allow the medic or care providers to deliver care to the right casualties at the right time and with the right resources.

Expansion of the "Golden Hour" will be key on the future battlefield, as medics will likely be required to care for the combat injured for much longer periods of time than previously considered – possibly upwards of 72 to 96 hours – before evacuation can take place. (USAMRDC Public Affairs)

Dr. Lawrence: We have taken the call to extend the "Golden Hour" very seriously, developing performance requirements that are effective and useable at lower echelons of care while minimizing the logistical burden and user expertise required to provide care while waiting for transport.

Patients who experience severe trauma or bleeding are at an increased risk of developing complications such as shock and organ failure. That's why WPAC is initiating a pre-hospital anti-shock drug to prevent or mitigate tissue hypoxia and the burden of shock. An anti-shock drug can extend the "Golden Hour" for Warfighters by helping to stabilize their condition and prevent further deterioration. We are also investing in a broad-spectrum snakebite antidote to quickly neutralize the snake venom at the point-of-injury and prevent it from spreading throughout the body, which can significantly reduce the severity of the bite and limit damage. Additionally, by reducing bite severity, this antidote can help stabilize the patient's vital signs and prevent shock from setting in.

C&CC: The Army's enduring commitment to its people – its Soldiers – plays an outsize role in the Army 2030 initiative. How do leaders such as yourselves cultivate young talent? More broadly, what is your method for ensuring that your people have the tools required to complete their respective missions and accomplish their respective goals?

COL Pamplin: Leading by example, empowering team members, and encouraging two-way communication are key components of creating a culture where team members can grow. More specifically, TATRC has adopted a series of processes known as the "Objectives and Key Results" system – or the OKR system – which are outlined by John Doerr in his book "Measure What Matters." This system highlights a simple process that allows teams to communicate more effectively about the most important work, focusing efforts and re-prioritizing resources as needed to collectively accomplish the mission.

COL Koenig: Recruiting, cultivating, and retaining the best and brightest military and civilian team members is a priority here at WRAIR. As the Army's transformation has picked up steam, we've had to ask a lot of our people to pivot their research focus to new and evolving priorities and step into new leadership roles. It is critical that we give them the tools they need to sustain mission accomplishment. We want our people to thrive, even in the face of change. As a senior leader in the organization, my approach is to ensure the whole enterprise has a shared vision of WRAIR's priorities and mission focus, while coaching and mentoring the next generation of leaders. The goal is a concerted effort in leader development and process improvement to more effectively-deliver medical solutions for the Warfighter.

CLOSING THE GAP BETWEEN VIRTUAL AND REAL WORLD

The Defense Health Agency (DHA) is promoting advances in medical simulation to help prepare for the future of military medical care.

By Terry J. Goodman, DHA Strategic Communications

Capt. Morgan Bobinski and Capt. Lauren Blake, both Burn Intensive Care Unit nurses, treat a simulated patient during the Tactical Trauma Reaction and Evacuation Crossover Course (TTREX) at Joint Base San Antonio – Lackland, Texas. The TTREX is designed to test and validate Individual Critical Task Lists and the Comprehensive Medical Readiness Program for military medical personnel. (DoD photo by Jason W. Edwards)

Technological advancements have dramatically changed how modeling and simulation are used to teach and train U.S. military's medical personnel. Virtual reality will be no exception. As artificial intelligence and augmented reality continue to rapidly evolve and become part of everyday life, their application in health care simulation in hospitals and in combat will become routine for tomorrow's military medical professionals.

In July 2023, the Defense Health Agency (DHA) opened its newest simulation center at Marine Corps Base-Camp Lejeune, North Carolina. The Healthcare Simulation and Bioskills Center provides medical professionals a facility that will support operational medicine and clinical education. The 2700-square foot building consists of two simulation rooms with video capabilities and two debriefing rooms. The center also features a skills task training room to help with individual competency development.

The Defense Medical Modeling and Simulation Office (DMMSO) leads DHA's efforts in centralizing management of the military's medical modeling and simulation capabilities and solution supporting medical education and training within the Military Health System by supporting the development, management, and integration of requirements, capabilities and systems for health care operations and improving medical readiness, survivability, quality of care, patient safety, and efficiency. The office is part of DHA's Education and Training Directorate. DMMSO was involved throughout the development of the simulation center at Camp Lejeune ensuring it would meet the training needs of providers.

APPLYING SKILLS TO REAL-WORLD APPLICATION

Simulation centers throughout the Military Health System (MHS) use multiple simulation devices to support their training efforts. Some of the most common are the use of manikins and standardized patients. Simulations provide students with a safe environment to practice skills in advance of treating patients. Although there are challenges when using simulation in training, the advantages outweigh them significantly. Ruben Garza, DMMSO chief, said clinical simulation is important for all staff, from physicians to nurses to technicians. Simulation training seeps into readiness, keeping our staff at a high level of "being ready." Forward deployed medical personnel of all types – physicians, medics, nurses -- must possess a complex set of knowledge, skills, and abilities. But there are often challenges in maintaining those skills in health care training settings where caseloads and case mix may not offer the right sorts of training opportunities. The whole range of possible simulation environments are used as the primary solution to fill those gaps and sustain KSAs. Advanced computer-based models

and simulations allows health care professionals to gain hands-on experience in a safe and controlled environment. They can practice complex procedures, such as surgeries or emergency interventions without putting themselves or their patients at risk. Simulations can also be tailored to address specific learning objectives, enabling targeted training and competency assessment. The Defense Medical Readiness Training Institute (DMRTI), another division within DHA's Education and Training Directorate, is a joint organization staffed by U.S. Army, Navy, and Air Force service members. DMRTI, located at Joint Base San Antonio-Fort Sam Houston, Texas, offers both resident and non-resident joint medical readiness training courses, as well as professional medical programs to servicemembers of all ranks. DMRTI offers 32 courses in combat and trauma medicine, emergency management and public health, emergency medicine and response, and medical operations. Simulation technology provides students with realistic training, improving their medical skills in the hospital and in the field. "In our schoolhouses at the Medical Education and Training Campus, DMRTI, Medical Center of Excellence (MEDCoE), and others, simulation is a big part of training," Garza said. "They have equipment on-hand to provide groups with rotations to practice. Models vary depending on the objectives needed for students, from basic to advanced."

Army Staff Sgt. Ilan Rafeel, noncommissioned-officer-in-charge, Role II Simulation Combat Casualty Care Course, at DMRTI, sees the power of simulation and modeling daily and its effectiveness in preparing servicemembers to provide care when serving at military hospitals and during deployments. "With the current technology in combination with high-fidelity training aids, our training courses at DMRTI allow over 700 healthcare providers annually to experience training that is incredibly close to real-world situations," said Rafeel, a combat medic who deployed to Afghanistan in support of Operation Enduring Freedom. "Medical modeling and simulation ensure our staff can create scenarios that cause an emotional response from trainees and replicate what may be experienced in real life, putting their knowledge and critical thinking to the test."

Mr. Joe Ruisi, Deputy Chief and Administrator, Medical Modernization Division, Air Force Medical Modeling and Simulation Training Program (AFMMAST) said, "Models and simulations lead to improved decision-making, better surgical outcomes, and enhanced patient safety. Simulation provides a realistic environment for healthcare professionals to practice their skills, refine their techniques, and gain experience in handling critical situations." He continued, "Through simulations, they can practice complex procedures, such as surgeries or emergency interventions, without putting patients at risk."

U.S. Army MEDCoE's Directorate of Simulation at JBSA-Fort Sam Houston, is the Army's lead agency in medical modeling and simulation policy and strategy, which supports institutional medical training, professional military education, and operational medical readiness training. The directorate also serves as the accreditation agency and proponent for all Army med sim centers, facilities, and activities. Army Col. Kathleen Samsey, who leads MEDCoE's Simulation Directorate, said simulation is a force multiplier in both health care and force readiness. Simulation provides safe operating spaces, data that shapes the training, and access to extreme environmental factors that are not available in real-word applications for various reasons. Simulation continues to offer warfighters unique training opportunities. However, there are some disadvantages. "Many simulators do not allow for adjustment of body mass types, or complicated anatomical shapes, placements, and sizes," she said. "This can lead to false confidence and competence in a skill by performing a procedure or intervention in a controlled low stress environment on an uncomplicated device with unrealistic reactions/responses. However, simulation must continue and evolve as new technology becomes available."

ADVANCED TECHNOLOGY FOR ADVANCED READINESS

DHA's Medical Education and Training Campus (METC), at JBSA-Fort Sam Houston, trains more than 16,500 enlisted military students annually in 49 medical training programs. More than 5,500 students are on campus daily training to provide medical care at military hospitals, in combat and during humanitarian missions. Medical simulation and modeling are relied upon heavily to provide realistic training and preparing them to serve no matter the military environment. "METC utilizes medical modeling and simulation to provide comprehensive training to military medical personnel," Ruisi said. "Simulations are used to teach and assess clinical skills, critical thinking, and teamwork. The use of virtual patient simulations, computer-based learning modules, and high-fidelity manikins enhances the educational experience of healthcare trainees at METC."

Brooke Army Medical Center (BAMC), also at JBSA-Fort Sam Houston, has used medical simulation since 2003 after receiving

its first human simulator. This was only a year after several faculty returned to Brooke after visiting the Medical Simulation Center at Harvard University. The group realized medical simulation was the future of medical education. Today, Brooke's SIM Center consists of six centrally-controlled simulation suites designed to replicate operating rooms, intensive care units, hospital wards, and trauma rooms elsewhere in the medical center. Each suite has full audio and visual capabilities to hear, see, and record all that occurs during each simulation scenario. To add to this experience, instructors can be in the control suite with the simulation operator, allowing trainees to use and test their skills without interruption. U.S. Air Force Maj. (Dr.) Hunninghake serves as the chief of the BAMC Simulation Center and San Antonio Market simulation representative in the San Antonio Market said simulation is not only important for primary hands-on education, but also the sustainment of skills and knowledge.

"I became a 'simulationist,' a true believer in simulation, when I attended my Critical Care Air Transport training at CSTARS [Center for the Sustainment of Trauma and Readiness Skills] in Ohio," said Hunninghake, who is also the flight commander for the Pulmonary, Respiratory, and Hyperbarics Flight, 959th Medical Operations Squadron. "The level of fidelity for the simulation scenarios, airplane noise, and dim lights all combined to recreate the stressful environment of transporting one or more critically ill patients at 35 thousand feet for up to 10 hours at a time. When I deployed, I felt truly ready to do my job as a CCAT physician. I want to recreate that experience for everyone who participates in simulation."

The Uniformed Services University (USU) of Health Sciences' Val G. Hemming Simulation Center was established in 1999 to provide a variety of simulation experiences to the military's future doctors and nurses. Today, the center provides more than 38,000 hours of instruction using simulated patients, human patient simulators or mannequins, task trainers and virtual reality to medical students, graduate nursing students, physicians, and allied health personnel. Within the center there are a variety of training tools available to students, including simulated clinical exams, trainers designed to improve medical skills, and the immersive Wide Area Virtual Environment, known as the WAVE, which is used to train military members in combat and disaster skills. Stepping inside the large-scale, immersive, virtual reality theater, students are made to feel as though they have stepped into the midst of a fire fight on the battlefield, or inside a field hospital, or in a helicopter – all portrayed with 3D images on large, vertical screens.

BUILDING THE FUTURE OF ANYWHERE CARE

The Defense Health Agency, collaborating with the military services and the USU, have made tremendous strides in the use of simulation and modeling. The collaboration will continue well into the future as the relationship between the services and DHA grows stronger, which is great for patients and doctors, nurses, medics and corpsman, and technicians of all sorts. The development of artificial intelligence (AI) and augmented reality (AR) is expected to make medical training more realistic, improving medical care at home and abroad.

"AI and AR will be an incredible supplement to modeling and simulation," Rafeel said. "This capability will allow training to occur in any setting, whether a jungle, village, or city. Users can be immersed into any scenario, any situation and experience a realism unmatched by what military providers experienced in the past and today."

PROMOTING HEALTH READINESS THROUGH PROACTIVE ASSESSMENT

Dr. Lester Martinez-López is currently serving as the Assistant Secretary of Defense for Health Affairs. In this role, he is the principal advisor to the Secretary of Defense and the Undersecretary of Defense for Personnel and Readiness for all Department of Defense health and force health protection policies, programs, and activities.

Dr. Martinez, a family medicine physician, retired from the Army as a Major General and was the first Latino to head the Army Medical Research and Materiel Command, where he directed the Army's worldwide medical research, acquisition, and logistics program. His experience in military medicine also includes tours as the Commanding General of the Center for Health Promotion and Preventive Medicine, where he directed a worldwide public health organization, and command of three military hospitals. After retiring from the Army, he served as the Chief Medical Officer at the Brandon Regional Hospital in Florida and Senior Vice President and Administrator of the Lyndon B. Johnson General Hospital in Texas.

Dr. Lester Martinez-López

Assistant Secretary of Defense
for Health Affairs

Combat and Casualty Care had the opportunity to speak with Dr. Martinez-López regarding his vision and priorities for the Military Health System and current initiatives designed to support readiness and overall health for Servicemembers, their families and other beneficiaries.

C&CC: Can you explain how the Military Health System (MHS) is realigning its responsibilities to better support readiness?

Dr. Martinez-López: Health is a foundational aspect of maintaining high level of readiness in our armed forces. When most people think of military health care, often the first thing they think of is the care we provide during wartime, and of course, combat casualty care is a critical part of our mission. But so are other aspects of force readiness that may not be so readily apparent. Things like overall physical health, including preventive medicine and support for healthy choices; and mental health, which has rightfully received more attention recently. Family health is another frequently overlooked aspect of readiness. Our military health system is unlike that in most other countries because we not only have the responsibility to care for active-duty service members, but also for their families and retired members. Service members need to know that we are taking care of their families to have peace of mind as they serve. Worry about the well-being of loved ones causes stress, which has a direct negative impact on readiness.

The transformation of the MHS is nearly complete. This is a once in a generation reform effort to improve the readiness of our forces and the health care service we provide to our warfighters, retirees and military families. The new construct is designed to increase overall access to care for beneficiaries; improve coordination, standardization, and dissemination of best practices across the MHS; and provide more opportunities for military medical providers to get the training they need to meet readiness goals. Part of that process involved the transition of responsibility for administration and management of military hospitals and clinics from the Army, Navy and Air Force to the DHA. Transition efforts began in 2018 and the final DHA region was established in October 2022.

C&CC: Based on lessons learned from previous conflicts, how has the MHS changed its approach to combat casualty care?

Dr. Martinez-López: We are involved in a constant assessment and learning process, incorporating experience from past conflicts and working to anticipate future needs. For example, in the most recent conflicts, we applied three key interventions based on battlefield experience that resulted in a 44% reduction in mortality. They were the use of tourniquets, blood transfusions and speedier MEDEVAC operations.

The Joint Trauma System is focused on both the past and present, documenting trauma cases and providing necessary data for performance improvement. This evidence-driven approach is the key to improving trauma readiness and outcomes.

U.S. Air Force Air Mobility Command Aircrew members assigned to the Training and Operations Branch, perform lifesaving treatments on moulage patients during a Joint Force Aeromedical Evacuation training at Yokota Air Base, Japan in July 2023. The training was a crucial aspect integrated into Mobility Guardian 23, a critical platform to showcase adaptability and proficiency of Joint Force Aeromedical Evacuation teams operating in challenging and dynamic environments. (U.S. Air Force photo by Master Sgt. Todd Olsson)

The Department of Defense Trauma Registry (DoDTR) is the first and only DoD trauma patient registry to collect combat casualty care epidemiology, treatments, and outcomes from point of injury to recovery. The DoDTR contains identified information taken from medical records, expert clinical inference, scoring and coding schematics, probability determination and PI data.

C&CC: When it comes to future threats, how is the MHS focusing its research related to combat casualty care?

Dr. Martinez-López: Our Combat Casualty Care Research Program is currently focused on a series of improvements, including battlefield resuscitation and immediate stabilization of combat casualties, severe burns and neurotrauma, technology advancements in autonomous care and evacuation, and sustainment of expeditionary medical skills. Anticipating the future environment and applying technology to challenges in C3, trauma care and mass disasters and the development of solutions is the key focus of this program.

Innovation priorities include shelf-stable blood products, improvements in TBI care, complex wound management, novel approaches to non-compressible hemorrhage, and prolonged care and evacuation.

Our COVID experience, also reminded us we need to be ready for new and old medical threats. Our old enemies like malaria and dengue persist and new ones are waiting. We must create a medical research environment, ready to address the known and anticipate the unknown threats in real time. We owe it to our service members.

C&CC: There is currently a lot of discussion about artificial intelligence and its role in our daily lives, what are some of the innovations the MHS is exploring and what role will automation play in the future? How do you see AI contributing to the success of the MHS in the future?

Dr. Martinez-López: Currently, several projects are underway involving machine learning, a subset of AI, using algorithms trained on DoD data to generate insights or perform complex tasks. For example, we are exploring the ability of this technology to predict opioid overdose risk and mental health issues. As AI continues to mature, we will need to look at its potential to help deliver health care by delivering care more efficiently, informing care with reliable data and analysis, and allowing providers to effectively help more patients, concentrating their time where it is most valuable. This will require high quality data, mapped to standards and the right infrastructure, keeping in mind the strict privacy requirements associated with health information.

All of this emphasizes the point that ultimately, funding will be the determining factor in how quickly we can realize benefits from AI.

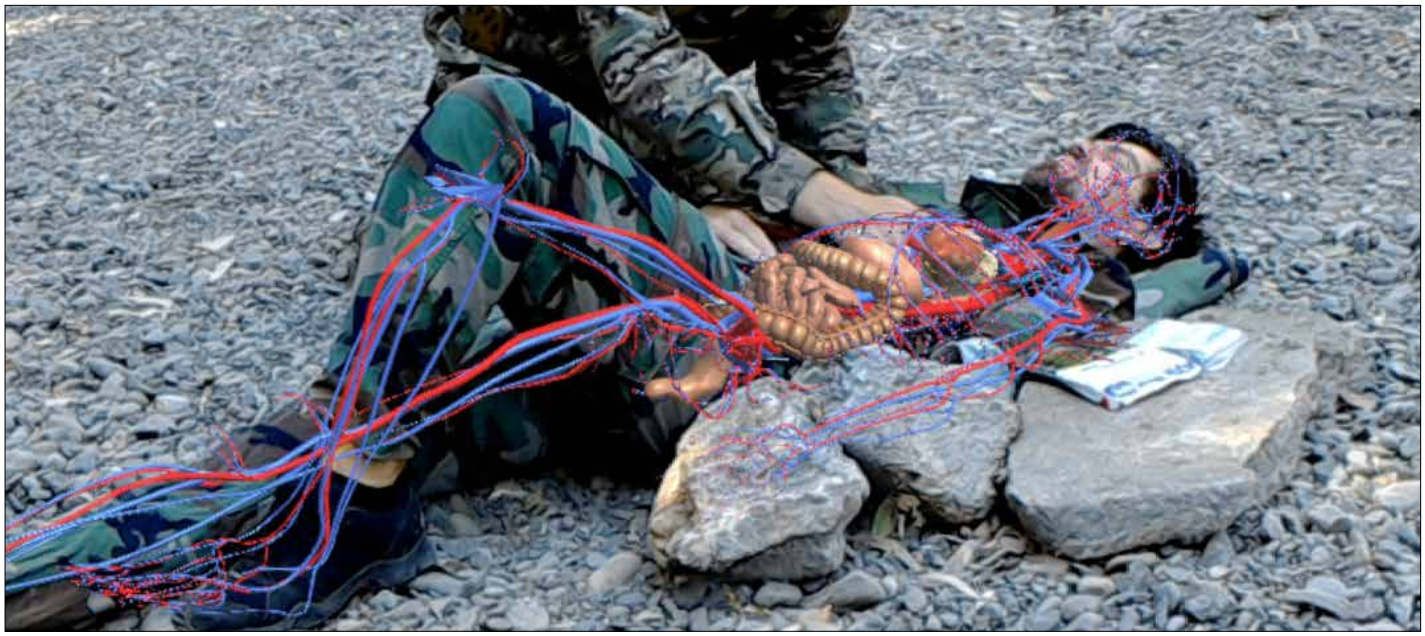
C&CC: What did the MHS learn from the pandemic response that can be applied to combat casualty care?

Dr. Martinez-López: First, COVID emphasized the fact that the ability to quickly adapt to changing situations on the ground is critical to success. Failure to respond quickly and effectively not only results in loss of life but creates a lack of confidence in the ability to provide a timely response to those in need. Second, the need for a standardized reporting system is paramount across the health care system to provide a common operating picture. Third, our experience validated our understanding that success depends on partnerships to share knowledge and quickly develop technology solutions. Fourth, health risk communication is key to creating a trust environment with our patients. Finally, it proved the value of telemedicine as a force multiplier to stretch limited healthcare resources and keep patients safe. Telemedicine allows us to deliver clinical expertise to the point of need quickly and efficiently. It will no doubt play an increasing role in health care, both physical and mental health.

SECOND SIGHT: VISION FROM A BRAND NEW PERSPECTIVE

The U.S. Army Medical Research and Development Command's Institute of Environmental Medicine (USARIEM) is pushing the augmented reality envelope, integrating information into the medic's world.

By Dr. Gary Zientara, Senior Research Scientist, USARIEM



Mock-up of what a battlefield casualty might look like using a new augmented reality tool. (Dr. Christoph Leuze, Nakamir Inc., Palo Alto, CA)

What if a medic could see inside a wounded Warfighter? The X-ray vision-like capability could aid the medic in decision making, as well as increase the safety and efficacy of treatment. With the challenges forecast for future multi-domain operations (MDO) – higher casualties, fewer medics, reduced evacuation opportunities – emphasis on efficient, efficacious triage and quality prolonged field care (PFC) will be critical for medics. State-of-the-art technology, in this case augmented reality (AR), puts detailed authoritative graphics and text information in front of a medic's eyes and will increase survivability.

Devising high technology innovations to aid Army medics on the battlefield is a top priority for the Army, and one required to meet the projected demands of the multi-domain operations battlefield. The combined ideas of Lt. Col. Robin Cushing, former chief of USARIEM's Office of Medical Support & Oversight (OMSO), Kristin Joltes, physician assistant with OMSO, and USARIEM medics led to the Defense Health Agency Small Business Innovation Research (SBIR) project, "Augmented Reality Surgical Visualization Tool for Combat Casualty Care." This project will bring anatomy graphics and triage information to medics wearing the newly introduced Integrated Visual Augmentation System (IVAS) using AR. The SBIR program has given life to a valuable Army medical tool – a proud product from USARIEM's design.

The IVAS is a modified form of the Microsoft's HoloLens 2 self-contained untethered AR goggles.

MANIPULATABLE VIRTUAL REAL TIME

AR refers to technology that merges graphical object, images, or textual information into what appears in our natural scene field-of-view using goggles, glasses or another display medium. The IVAS AR display for this project's software is accomplished by superimposing graphics or text onto the display lenses, thereby augmenting the medic's real-world field of vision. AR content is selected by the briefest of verbal commands. The medic can also preset the conditions for display, such as the opacity of the AR display, to suit individual usage.

The idea was to create on-demand internal anatomy, registered and displayed by the IVAS onto the view of a wounded Warfighter. This creates an "x-ray vision-like" view for the medic showing a mock-up view of the patient. Specific anatomy, such as a skeleton or an entire cardiovascular system, could be viewed or removed from a more comprehensive view of internal anatomy to best aid the medic's treatment. As an option, textual information can be added to the side of the IVAS display lens to provide review of triage or treatment basics. Used for surgical visualization at the point-of-injury (POI), the objective of the medic's AR anatomy aid is to assist decision making and increase the safety and efficiency of treatment.

AR emerged from surgical visualization as eyeglass and goggle display technology evolved. Surgical visualization was an early 1990's forerunner of this medical technology. The intended benefit in surgery was clarity of the procedure's target anatomy that ordinarily would be obscured by layers of tissue. From this surgeon's view resulted better surgical decision making, and safer and more efficient procedures. The SBIR project derives its benefits from this approach married to headset display.

In the early phase of the project, Cushing and Joltes identified key combat casualty care scenarios that the AR medic's anatomy tool would encounter, posing challenges for treatment, such as gunshot wounds, blast injury, criciothyrotomy and pneumothorax. They also suggested the terse verbal commands that a medic might issue to manipulate the IVAS AR graphics – for example, "show cric landmarks" or "show ribs."

Example of cricothyrotomy landmarks registered to the subject in the medic's view using the medic's AR anatomy tool. (Dr. Christoph Leuze, Nakamir Inc., Palo Alto, CA)

Additional suggestions for the tool's usage were contributed by Maj. Andrew David Fisher, Texas Army National Guard, and Maj. Brandon Carius, formerly from the Farrelly Health Clinic in Fort Riley, Kansas, now at Joint Base San Antonio, Texas.

As part of the SBIR program, two new businesses were launched to take on this development, bringing the AR medic's anatomy tool to reality. The two SBIR Phase II were chosen, each with prior knowledge of medical visualization and the nascent AR technology.

AR visualization is produced by a significant amount of background computation optimized to execute in real-time so the medic sees no delay. The scene of the wounded Warfighter is viewed and processed on the IVAS by computer vision while a different type of software determines the orientation of the Warfighter's body. For robust, accurate pose recognition, follow-up SBIR funds were issued to specifically train the HoloLens 2 machine learning software using thousands of synthetic images of wounded Warfighters in different environmental conditions. In the past, Hololens 2 software was trained originally using standing civilian figures.

Medic's view through Hololens 2 (basis of IVAS technology) in a live demo. (Danielle Johnson, Augmntr Inc., Berthoud, CO)

ADVANCED ACUITY FOR REAL-WORLD CONSTRUCT

Next, standard gender-specific surface-rendered anatomy is morphed to fit to the Warfighter's body surface and carefully formatted - or "registered" - for accurate 3D overlay. Special software accounts for the movement of the medic and the patient, so the IVAS combined scene remains faithfully depicted. Natural language processing software translates verbal commands to visual changes seen on the IVAS lens.

The two versions of the AR medic's anatomy tool were developed using an additional lightweight, puck-sized compute server to work alongside the similar-sized IVAS computer. This enables millisecond execution times for the compute steps in the visualization.

Different aspects of illumination could affect the visibility of the IVAS display. Therefore, research was conducted in bright sunny or cloudy atmospheric conditions, precipitation, bright or dull snow conditions, fog and moonlit conditions and complete darkness, and indoor conditions for visibility.

Using manikins, software usage in cases of varying patient skin tone, wound type, clothing color, tattoos and missing limbs was studied. Natural language processing software was also tested, which understands the medic's commands under conditions with background noise of 30 to 100 decibels.

Anatomy display result demonstrating how pose recognition is key to the registration of anatomy with the subject in the FOV of the medic's AR anatomy tool. (Dr. Christoph Leuze, Nakamir Inc., Palo Alto, CA)

The IVAS was demonstrated at the 928th Area Support Medical Company of the Army National Guard at Fort Carson, Colorado, and at the Military Health System Research Symposium (MHSRS) 2022, with human volunteers and manikins.

Following the demonstration, the 928th Area Support Medical Company of the Army National Guard participants provided a list of desired extra features they desired in the AR medic's anatomy tool software, including videos for training, vital signs display, body temperature display and the display and control of information or contacts that would otherwise require a handheld or computer.

FORCE EXPOSURE TO WHAT'S POSSIBLE

In addition to the Army demonstrations, the AR medic's anatomy tool has been demonstrated at the Marine Corps Base Camp Pendleton in Oceanside, California; to attendees of a Prolonged Casualty Care course at Strategic Operations in San Diego, California; and to U.S. Navy personnel from the Naval Special Warfare Command.

In all demonstration cases the favorability rating was high, though some questioned if the AR anatomy graphics could pose an unwanted distraction during the urgency of point-of-injury triage and treatment – suggesting prolonged field care was more appropriate. Others suggested a rearrangement of the information on the IVAS lens, or even more information but added off to the side of the lens almost in the medic's peripheral view. That experience with the training application of the AR medic's anatomy tool is of utmost importance. Subsequently, as medics become familiar with AR, the acceptance of its use during battlefield triage and treatment will be easier.

With the IVAS, each medic can have a 21st century always-available training tool, and then could invoke the key functionality from the tool when at a point-of-injury. As a combat casualty care tool, the IVAS is a key battlefield asset for medics, as well as a powerful training tool. The IVAS adds to medics' expertise – and will help to support the health and resiliency of our Warfighters.

RETHINKING TRADITIONAL TO EMPOWER THE FORCE

The U.S. Army Research Institute for Environmental Medicine is backing biomedical scientific study of the female body to provide feedback aimed at producing higher level combat performance.

By Maddi Langweil, USARIEM Public Affairs

A U.S. Army Ranger performs the VO2 Peak test during the Female Elite Warfighter Study at the U.S. Army Research Institute of Environmental Medicine (USARIEM). The Research Institute focuses efforts to conduct research, identify challenges and provide research behind updates in policy to improve the safety and performance for our women in uniform. (USARIEM photo)

As people around her cast skeptical glances, Rebecca Cherian remained resolute. She knew her capabilities and dedication spoke louder than their doubts. With a raised chin and confident posture, the Soldier proceeded to her station to do what she knows—serve.

"I am a woman and proud to be one," she said. "But I want to be seen as a Soldier; minus the pronoun as in 'female' Soldier."

Rebecca Cherian

BREAKING THROUGH STEREOTYPICAL BOUNDARIES

Cherian knew she wanted to make her mark in the world and contribute to society in some form. Before enlisting in the military as a laboratory technician where she supports Warfighter-faced experiments, she was a wildland firefighter. But both fields Cherian has worked in are generally male-dominated ones that often come with some scrutiny from others.

"Initially, my struggle with my firefighting crew was them not believing I was strong enough to handle the job mentally or physically. After a few projects together, I earned their faith and confidence that I was just as capable as a man. After this introduction period with my primary crew, any new or temporary crew that got added did not doubt me as a female contributor for long because my primary crew would always vouch for me," she said. "With the military, I face the same criticism."

What Cherian has faced is not new to women in fields that are largely male-dominated. Women have faced decades of hardships, especially when looking to break the ceiling on "traditional" female roles in society and the workplace. However, with determination, women willing to invest in the fight have opened new opportunities for those women following behind them. This may include women in an operational role in tactical fields like the military, medicine and in science. With these opening doors, ultimately, a greater representation of women can be included in biomedical research.

To date, most of the biomedical research aimed to improve Soldier performance and health has been conducted on men says Gabrielle Giersch, research physiologist in the Thermal and Mountain Medicine Division at the U.S. Army Research Institute of Environmental Medicine (USARIEM). Since several women serving in the military have all job categories open to them, there are now more questions than answers, and many researchers are nearly building a house from the ground up, she says.

Gabrielle Giersch

Together, the USARIEM team is formalizing efforts to build a network of subject matter experts aligned to study female Warfighter health and performance. The aim is to work collaboratively with other government and academic colleagues to answer female-focused performance and health research questions, then disseminate the outcomes to aid women in uniform.

UNEARTHING FEMALE CHAPTERS OF MILITARY HISTORY

Women have established their presence in the military for centuries, from the American Revolutionary War to World War I. However, it was not until later in history when females could expand their efforts from nurses and "Hello Girls" to other opportunities in the field such as infantry Soldiers. Women serving in the military has been open for over 70 years upon the ratification of the Armed Services Act in 1948—an act that granted women the ability to serve in the military in noncombat roles. It was not until after in the mid-1970s when women were permitted to enroll in military service academies, such as the Naval Academy and U.S. Military Academy, but they were still excluded from serving in combat roles. There was little progress in enlisting women in direct combat activity until a just over a decade ago where Allied nations such as the British Ministry of Defense found there to be equal performance between male and females in 2010. Three years later, the Australian Army opened frontline roles to women. By the end of 2015, U.S. Secretary of Defense Ash Carter lifted the Combat Exclusion Policy – which excluded women from serving in combat roles, which then unlocked all roles and Military Operational Specialties (MOS) to women.

"In the years following when the no exclusion policy was lifted, then allowing women to work in any MOS, has caused a ripple effect of questions 'can women run at this pace' or 'are they able to lift this much weight at this speed and height?'" said Holly McClung, nutritional physiologist in the Military Performance Division at USARIEM. "These research needs all bubbled up more prominently over the last few years."

Holly McClung

In response to this rise in women in all MOSs, USARIEM Exercise Physiologist Marilyn Sharp developed research-based requirements to set the standard for each MOS. Her research aimed to answer: What tasks are required for each Army MOS? What tactical standard does the Soldier need to meet? This investigation led to designing the Army-wide Occupational Physical Assessment Test (OPAT). This test predicts the standard an individual would need to perform at based on certain job categories – independent of gender – ensuring individuals within specific MOSs could successfully complete the task the job requires. As there becomes a larger representation of women entering combat arms MOSs, there are new gaps in Soldier research that need to be filled and updated to support female Soldiers.

"There was, and still is, a lot of work that needs to be done." Giersch said.

BOOSTING PRESENT-DAY FEMALE WARFIGHTER RESEARCH

Some of the known physiologic factors that set women apart from men include body size and composition, skeletal properties, muscle strength, and fuel metabolism. An in-depth understanding of such variables can give researchers a better grasp of how to answer the long list of questions specific to women. Through a cascade of research, scientists have shown women are capable of physically and mentally performing at the same level, and even outperforming some male counterparts in certain soldiering tasks such as evaluating a casualty or engaging with targets.

Cherian says she has received a higher total score with her performance on the Army Combat Fitness Test (ACFT)—the Army's new physical fitness test of record—than many of her fellow female and male colleagues. "There are women who are willing and capable of performing to the same standards as their male counterparts for things like Air Assault, Ranger School, and Special Forces. Those opportunities require a certain level of skill to perform them safely and successfully," she said.

With more research on women, scientists are better at understanding how to fully optimize Warfighter performance and health. Piece by piece USARIEM is working to use research to influence how all Soldiers train, eat, sleep and prepare themselves during training and when out in the operational environment. "Our research is all about improving performance and reducing injury and apply the best science to make women better Warriors," McClung says. "As our knowledge base increases, then there are more women we can help." Once challenges are identified and researched, policies can be changed to improve safety and performance for the growing number of future women in uniform.

"It would be a huge accomplishment if by the time we retire the number of women compose the Army were to surpass 20%," Giersch said. "In the past few years, it has been around 16-17%, but the more we are able to support women in uniform, the hope is those numbers will grow."

CHARGING TOWARD THE FUTURE FEMALE

Each morning as the sun rises, Cherian and Soldiers like her put their uniform on, lace up their combat boots and head out for the day. A day that may vary, but one that gives Soldiers purpose and meaning. The experiments done for female Warfighter health and performance within USARIEM aims to support the present and future Soldiers, like Cherian, to continue to stand tall and feel proud, healthy, and prepared to do the job they have been trained to do.

"This effort is building off previous work, much of which was done here at USARIEM, and forging collaborations to ensure that the female Warfighter is healthy, safe and performing optimally," Giersch said. "This work is powerful to all of us."

As this work continues, more women and better Warriors can transpire in the Army.

"I believe that if you are a Soldier, you should be expected to perform to a certain level and that bare minimum expectation should not be overlooked or lowered to allow females to 'feel' included," Cherian said. "I signed up to do this job and I want to believe that I am successful in this field because I work hard for it."

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EMS World Expo
New Orleans, LA
Emsworldexpo.com

SEP 27 – 28
Government Biotechnology Innovation Summit
National Harbor, MD
Biotech.dsigroup.org

OCT 9 – 11
AUSA Annual Meeting
Washington, DC
Meetings.ausa.org

OCT 11 – 12
DOD/VA & GOV Health IT Summit
National Harbor, MD
Healthit.dsigroup.org

OCT 23 – 25
Air Medical Transport Conference
Columbus, OH
aams.org/page/AMTC23

JAN 23 – 26, 2024
SHOT SHOW
Las Vegas, NV
Shotshow.org

MAR 26 – 28
AUSA Global Force Symposium
Huntsville, AL
Ausa.org/meetings

MAY 5 – 9
Aerospace Medical Association Annual Meeting
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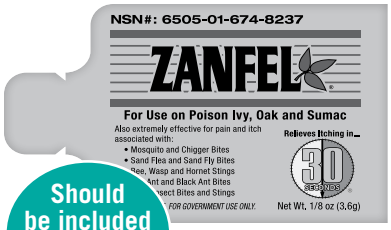

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