COMBAT & CASUALTY CARE

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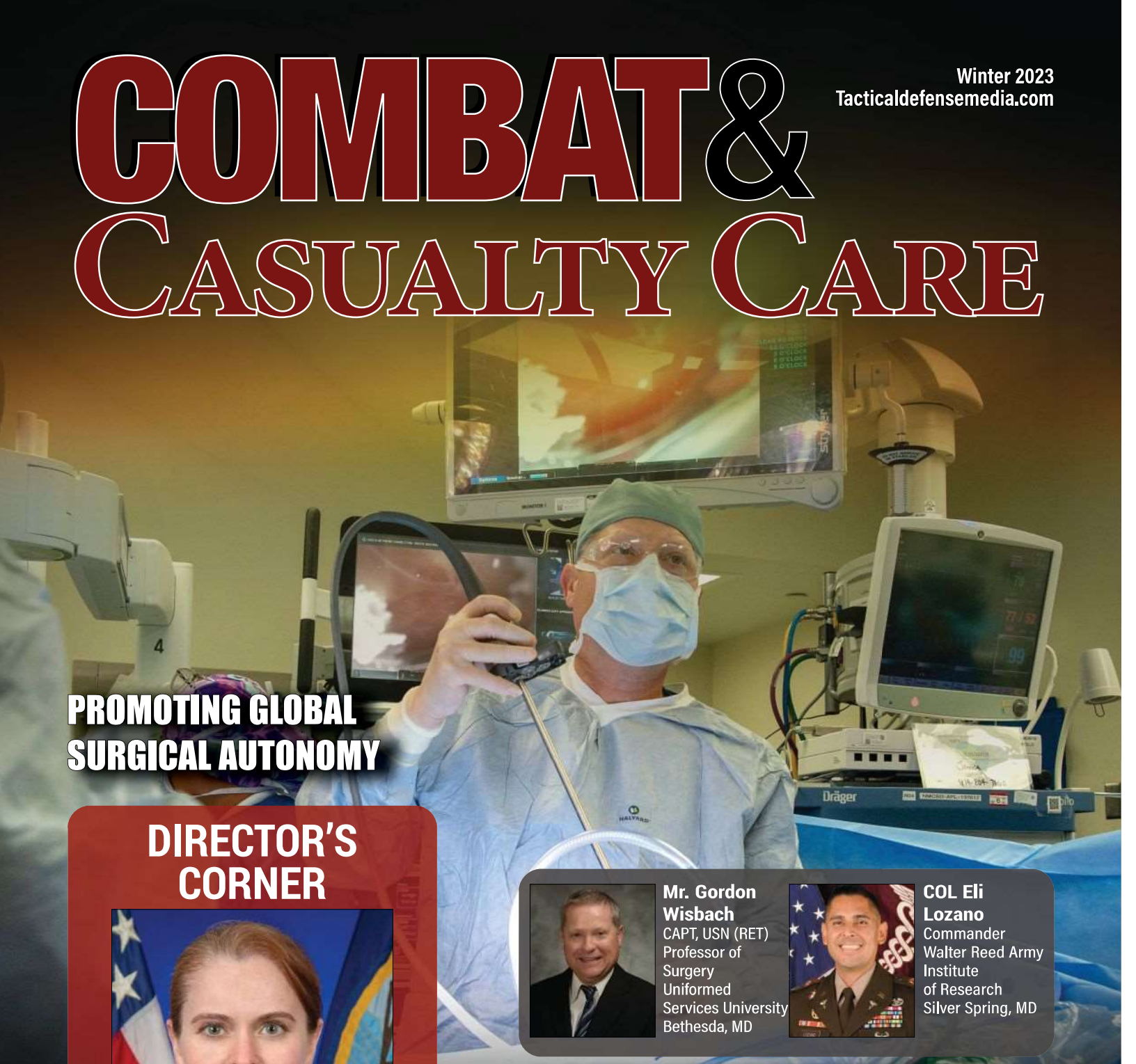

PROMOTING GLOBAL SURGICAL AUTONOMY

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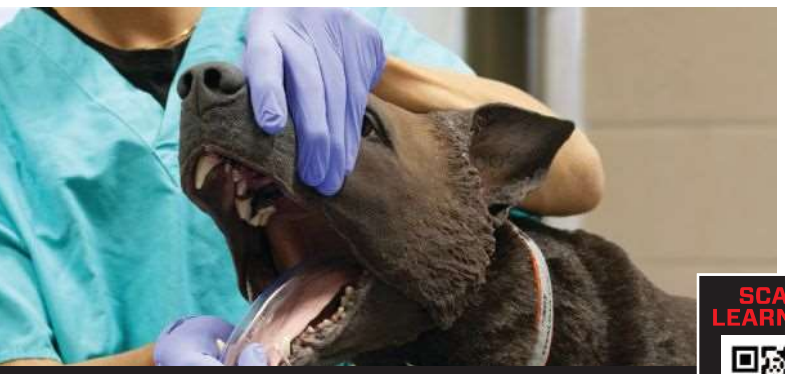

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TELEROBOTIC SURGERY: ADVANCING AVAILABILITY THROUGH AUTONOMY

U.S. Navy Medical Center-San Diego is leading Department of Defense efforts to push capabilities in next-level robotics-aided surgery, opening the way for execution of global lifesaving procedures.

By CAPT (USN Ret) Gordon Wisbach

Features

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PROMOTING CARE INNOVATION

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LEADERSHIP PERSPECTIVE

ALIGNING RESEARCH WITH FUTURE NEED

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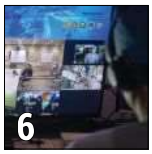

NEXT-LEVEL SURGICAL SUPPORT LEVERAGING TELEROBOTIC INNOVATION
The Military Health System may soon use automation to enable surgery in austere locations where surgeons cannot always physically be, increasing casualty survivability and rates of return to battle.
Panel Interview with Leading Military Experts

TELESURGICAL ROBOTICS TO BATTLEFIELD CARE
The U.S. Army recently launched its collaborative Telesurgical Robotic Operative Network (TRON) research project to push access to critical surgical capabilities worldwide.
By Ethan Quist

INDUSTRY SPOTLIGHT

MULTI-ENVIRONMENT MEDICAL EGRESS
SKEDCO, Inc., a leading producer of medical extraction equipment, has introduced its latest litter capability.
By Bud Calkin

Departments

TARGETING EFFECT OF THE BLEED
The U.S. Army is testing the latest in pharmaceuticals designed to help prevent hemorrhagic shock, a primary complication experienced by combat medics administering point of injury care.
By Paul Lagasse

INDUSTRY PARTNER

SIMULATION RELEVANCE TO PROLONGED FIELD CARE
Changing landscapes of military conflicts require rethinking casualty care for the wounded.
By LTC (Army Ret.) Walter Engle

INDUSTRY PERSPECTIVE

ANESTHESIA ON THE MOVE
Next-generation technology is extending critical care capabilities in complex or austere deployment environments.
By LTC (Army Ret.) Steven T. Meyer

MEDICAL MATERIEL DELIVERY SUPPORTING WORLD-CLASS CARE
Interview with COL James A. (Andy) Nuce, Commander, U.S. Army Medical Materiel Development Activity, Fort Detrick, MD.

Cover: Capt. Gordon Wisbach, Navy Medicine Readiness and Training Command (NMRTC) San Diego's Virtual Medical Operations Center (VMOC) telesurgical director, prepares for a robotic-assisted gallbladder removal surgery at NMRTC San Diego last May. During the surgery, Capt. Wisbach communicated with Naval Hospital Camp Pendleton staff members remotely for telementoring. NMRTC San Diego's mission is to prepare service members to deploy in support of operational forces. (U.S. Navy photo by Mass Communication Specialist 3rd Class Mariterese Merrique)

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ARMOR & MOBILITY

INSIGHTS

The Winter 2023 Association of Military Surgeons of the United States (AMSUS) edition of *Combat & Casualty Care* shines a bright light on advances in autonomous capability in virtually-guided surgical procedure, technology that is changing lives globally already. With the differenace between life and death dependent in many cases on how soon treatment can be rendered, surgical expertise on screen to guide skilled hands operating on wounded personnel from anywhere there is accessibility to a live feed is a game changer emergency medicine has been awaiting. Count combat medicine in there for sure.

In this year-end/year-start issue of *C&CC*, we are pleased to offer readers a special feature on this amazing science in action along with a follow-on panel question and answer with Joint Services medical representatives speaking to a roadmap for full adoption and implementation across a globally-positioned U.S. Department of Defense. From Naval Medical Center-San Diego (NMCSD) and the Virtual Medical Operations Center (VMOC), one of the DoD's largest medical training facilities, CAPT Gordon Wisbach (USN Ret.), former NMCSD Telesurgical Director, we get an inside look at the future of telerobotic-driven operations where telementoring, telepresence, and potentially telesurgery can remotely guide surgical procedures without geographic limitations. As further partnering between the Services and private sector networks continues, the sky's the limit in terms of capability to leverage the tools to support critical concept development. We can see this growth at work in the Army Telemedicine and Advanced Technology Research Center (TATRC) collaborative Telesurgical Robotic Operative Network (TRON) research project created to support global surgical application in future large scale combat operations (LSCO) not limited to finite regional conflict but internationally-dispersed engagement.

As so much of what is created from a solutions standpoint in medicine is built on the foundation of existing proven concept, the leadership of primary centers of care such as Walter Reed National Military Medical Center (WRNMMC), Bethesda, MD, headed by Captain and Director Melissa Austin, is of critical importance to innovation of the present, for the future. With recognition that prolonged field care (PFC) a likely ongoing reality, particularly in future combat scenarios reliant on globally-responsive medical care availability, WRNMMC's focus is to continue marrying evidence-based know how with scalable application to produce positive outcome assurance amidst the tyranny of distance. Central to this projection of care is the ongoing improvement of capabilities addressing conditions such as hemorrhagic shock following trauma involving rapid blood loss. As such, the Blood and Shock Resuscitation Combat Casualty Care Research Team 1 (CRT1) at the U.S. Army Medical Research and Development Command (USAMRDC) Institute of Surgical Research (USAISR) is exploring an innovative alternative to blood replacement, using pharmaceuticals to help injured Warfighters survive longer even when they cannot get a timely transfusion.

Don't miss this issue's Leadership Perspective with COL Eli Lozano, Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and Medical Materiel Focus with COL Andy Nuce, Army Medical Materiel Development Activity (USAMMDA), Ft. Detrick, MD.

As always, feel free to send us comments and suggestions. Thank you for your continued readership!

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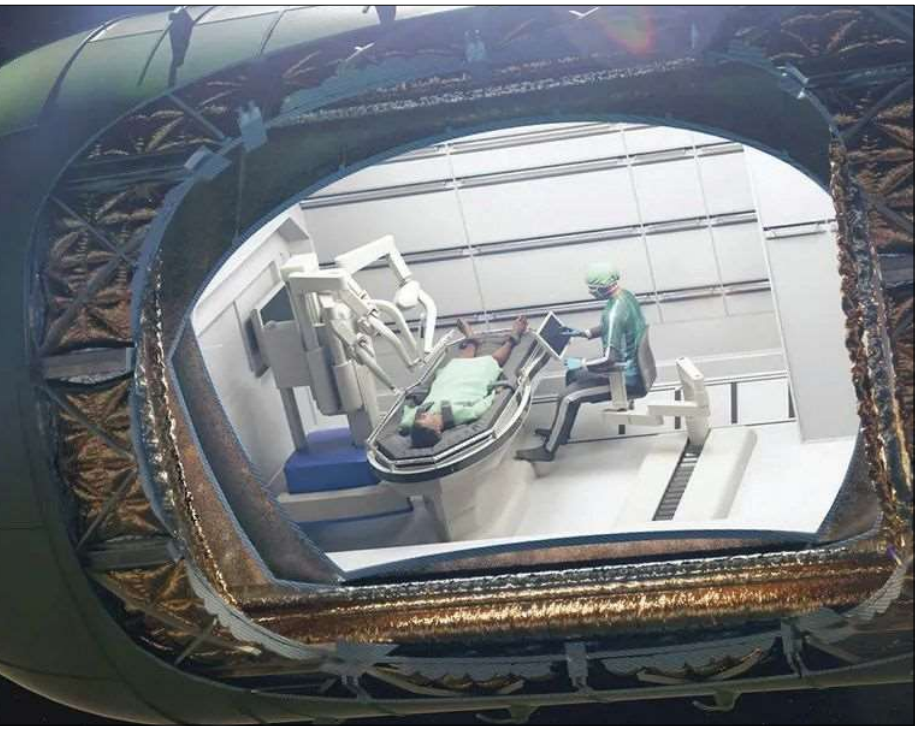
TELEROBOTIC SURGERY: ADVANCING AVAILABILITY THROUGH AUTONOMY

Naval Medical Center-San Diego (NMCSD) is leading Department of Defense efforts to push capabilities in surgical telementoring coupled with next-level robotics-aided surgery, opening the way for execution of global life-saving procedures by projecting expertise anywhere in the world.

By CAPT (USN Ret) Gordon Wisbach, NMCSD



Surgery in Space (artist depiction): For a crew of seven people, researchers estimate that there will be an average of one surgical emergency every 2.4 years during a Mars mission. The main causes include injury, appendicitis, gallbladder inflammation or cancer. (T. Trapp/ BJS Surgery, CC BY-SA)

In the year 2046, a NATO special operations team engages in a firefight with ground forces of a near peer adversary. A missile from an autonomous drone creates mass casualties in need of immediate care. These casualties are littered and evacuated to the nearby valley where the forward surgical team awaits. Inside the tent, a forward surgical team consisting of two general surgeons, an orthopedic surgeon, and an anesthesiologist, is preparing to receive the casualties. Due to the number of casualties expected, the team can power-up the semi-autonomous T2 surgical robotic assistants to double the current surgical capabilities. A signal pings the nearest role 3 combat support hospital and the global tactical robotic on-call surgeon based in CONUS requesting the remote surgeons to enter the surgical support pod for surgical assistance. The FST surgeon can don his augmented reality (AR) headset to communicate with the on-call robotic surgeon and share his camera view and critical patient information such as the vitals and body registration. A secondary remote surgeon links into the headset for telementoring providing audio guidance and AR telestration guidance on the registered body. The three surgeons, one local, two remote, begin the operation. A laparotomy is performed to inspect the casualty. During the procedure as blood flow was detected in the abdomen. Instantly on detection, the surgical robot switched into autonomous mode for suctioning and identification of the source of bleeding. With the blood cleared, the local surgeon can clamp the bleeding vessel. Guidance from the telementoring surgeon led the local surgeon through a complex procedure while the surgical robot assisted. Immediate hemostasis and stabilization is achieved allowing the patient to be triaged to the next level of care at the nearest combat support hospital.

The scenario described above is somewhere between science fiction and future technology reality. It remains to be seen how far technology can advance to become a force multiplier for life saving combat surgeons. The scenario highlights the possible capabilities in the not-too-distant future for robotics and communication technologies to project expertise from safety to a combat zone to augment the abilities of a surgeon or medic. Of course, this concept is not new. Indeed, a similar future vision was the impetus of several government-sponsored research programs in past decades, which led to the development of dominant robotic surgery platforms currently employed in the commercial sector. It is time to re-examine the potential to realize this future vision through the lens of current technology advancements and the Department of Defense (DoD) future operating concepts.

TELESURGERY'S HISTORICAL BREAKTHROUGH

In September 2001, the Lindbergh Operation marked the first successful telesurgical procedure across the Atlantic Ocean, 5000 miles from New York to Strasbourg France, performing a Laparoscopic Cholecystectomy. Two years later, on February 28th, 2003, the first telesurgical procedure from Hamilton Ontario to North Bay, a 540-mile round trip operation, was performed. Over a period of 9 months, 21 complex telesurgeries all of which provided a quality-of-care equivalent to local expert robotic surgery. The biggest criticism at that time was that there would be a notion from patients not accepting a procedure where the surgeon was not in the room let alone the city. The reality was after the first few surgeries there was no real hesitancy from patients about the remote procedure because they knew it was a chance to receive expert care. The first setback to the research was that news on the telesurgeries at the time was more focused on the technology and not enough on the patient care and how these operations were providing the patient a better care experience. The second setback to remote telesurgery was when Intuitive Surgical bought up the entirety of the robotic surgical space and steered the technology away from remote surgery into local robotic surgery.

HOW TO ADVANCE AUTONOMY WHERE NEEDED

Since then, new partnerships with TATRC, DARPA, and NASA emerged all focusing on "how can we deliver surgical care in extreme environments and in the absence of a surgeon?" These research centers wanted to know how telesurgery would benefit casualties

on the battlefield or astronauts on the Moon or Mars. This led to the NEEMO Missions (NASA Extreme Environment Mission Operations), experimentation and training exercises which took place in an Aquarius Habitat in an underwater laboratory located off the coast of Key Largo, FL. The lab functioned as an extreme environment / space analog. The first in 2004 focused on Telementoring. The second, in 2006, focused on telesurgery. Using the S7, a surgical robot built by SRI International, they were able to perform an open system surgery. During the procedure they instituted a 2 second delay in the signal to simulate earth to moon communication. They found surgery was not feasible under those conditions and that the human brain can only really handle up to 300ms of delay to perform a safe and precise surgery. This led to the third NEEMO mission in 2007 to demonstrate automation which they accomplished in the remote setting. The NEEMO missions lead to the understanding that robotic control and advanced computing needs to be paired to accomplish difficult surgical tasks. This is especially apparent for NASA's requirements of Mars missions when there could be 7-to-40-minute time delays. Autonomy will be the only solution.

One beneficial technology advancement is the giant leap recently in Artificial Intelligence (A.I.). The natural marriage of robotics with A.I. would allow robotic systems to provide much better care. With advanced computing power they could develop care plans based on millions of patient data. Current research is with the Image-Guided Autonomous Robot (IGAR) used for breast cancer detection operating inside MRI machines. The IGAR has recently been paired with IBM's AI Watson platform which allows the robot to image, diagnose a lesion, plan and carry out a breast biopsy without any physician intervention. Three major advancements happening at the same time are the maturity of the surgical robotic platforms from commercial investment, advancement in communication technologies such as 5G which can change the way humans' interface with robotic platforms, and the emergence of Artificial Intelligence and autonomy in robotics. These three pieces occurring at the same time is opening the door for military investment in the technology, to project surgical expertise on the battlefield and in extreme environments.

TELEMENTORING CONTINUES TO PAVE THE WAY

Surgical telementoring will establish the foundation upon which telerobotic surgery can be integrated to project surgical expertise remotely with the goal of improving delivery of surgical / invasive medical treatment in the austere environment. Surgical telementoring would start in CONUS hospitals. It would then extend from CONUS hospitals to combat support hospitals and potential all the way to mobile medical facilities in the battlefield. Built on top of the telementoring backbone would be a similar telesurgical pipeline. Telesurgery would first to be adopted in fixed facilities and then to combat hospitals and to eventually Role 2 / Role 1 environments. A far future concept would be a surgical force multiplier where one surgeon is able to mentor, assist, and even lead surgical care across multiple casualties and cases from one central location. Robotic surgical assistance can act as a bridge between telementoring and telerobotic surgery. Remote surgeons would assist through a robot procedure, provide extra expertise but not introducing the risk of needing to be the lead surgeon in questionable communication environments. There will be an emphasis on establishing the capability and value of these technologies, specifically telementoring, requiring the establishment of clinical evidence, protocols, and methods. Telementoring will need to be extended out into the DHA clinical community through clinical trials, and finally extended further into operational platforms where telementoring is used in field hospitals and deployed ships.

It will start with assistive perception, leading to assistive robotics and finally to fully autonomous robotic systems. The envisioned assistive perception tools consist of patient data display, procedural guidance, and 3D registration of anatomy through Augmented Reality (AR) Heads-Up Displays (HUD). Digitalizing and interpreting medical data this way will also aide in developing assistive robotics, which require an understanding of this medical information. Assistive robots will be developed first for repetitive tasks such as suction & irrigation, tissue retraction, and suturing. These assistive tasks will provide a free set of intelligent hands to surgeons who find themselves in resourced strained environments. The road to full autonomy may come to robotic systems capable of airway management for casualties, image guided vascular access, autonomous diagnostic imaging at remote sites, and possibly even damage control robotic surgery. While many of these technologies seem far off in the future, work is already underway for many of these assistive perception and assistive robotic tasks.

LOOKING AHEAD AND LEARNING MORE

Research will continue to help develop autonomous robotic capabilities through advancements in telecommunications such as 5G and artificial intelligence (AI). To request more information on the Telerobotic Surgery Symposium, contact CAPT (Ret) Gordon Wisbach at gwisbach@gmail.com.

NEXT-LEVEL SURGICAL SUPPORT LEVERAGING TELEROBOTIC INNOVATION

Combat & Casualty Care had the opportunity to speak with some key leaders who participated in the Inaugural TeleRobotic Surgery Symposium in May 2021 regarding efforts to develop a Military Health System (MHS) roadmap for telerobotic surgery and telementoring researching in the U.S. Department of Defense. Experts remain focused on addressing ways in which automation and technology can enable surgery in austere locations where surgeons cannot always physically be, increasing casualty survivability and rates of return to battle.

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Telesurgical Director
Virtual Medical Center
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COL Jeremy Pamplin
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LTC Steven Hong
Chief
Head & Neck Oncologic and Reconstructive Surgery
Walter Reed National Military Medical Center
Bethesda, MD

C&CC: Speak to TATRC milestones and goals regarding the advancement of telementoring as pertains to telesurgical automation. How can the private sector be harnessed to participate in these needed technology and capability advancements?

Mr. Fisher: CAPT Wisbach and I started communicating about trying to push surgical telementoring farther forward to be more widely adopted. Our team at TATRC and our Science & Technology partners are developing long-term research projects and tools that we could leverage so we can eventually get to the end user. The intent here is to expand the team to all the relevant stakeholders and help refine the notional roadmap and develop a set of concepts that we can work together to move forward.

The question as to how we harness the private sector has been a conversation that has been going on for a while. We cannot do this without industry partners. I think that the commercial and clinical acceptance of these technologies must be more than just simply DoD driven, but we have the potential to affect the trajectory of these technologies to get more clinical expertise and rotations, particularly in more rural locations.

CAPT Wisbach: We wanted to develop this roadmap with the different key players: the 5G project, JAIC, ISR, TATRC, DARPA, etc., as they develop as research projects. We are focused on the infrastructure and the A-Team, as I like to phrase it, to move forward. We are looking at this technology and we know it has great benefit but what are early use case scenarios and early areas of adoption? If you use medical robotics as the analogy, you have prostatectomy that became the standard of care around 2006. That allowed robots to be populated in the hospitals and that began the new era. But without prostatectomy it would have been rolling the boulder up the hill continuously. Here we are, what are those cases? I think maybe rural hospitals where you have under resourced surgeons doing good work but they cannot get their specialists and have the outcomes they need. You can correlate that to the Role 2. If we can identify where we think we can get the most traction on a clinical standpoint with actual changing care and adoption. To just to kind of focus, there is a phased approach where you have the telementoring as a foundation, and then surgical telerobotic surgery infrastructure, and then application technology.

LTC Hong: I think the military is in a unique position compared to the civilian side. The problem in the U.S. I have learned is the non-technical barriers. The medical legal and credentials between states and hospitals in the U.S. will be the biggest challenge, especially when engaging in the rural setting. I think having these developments still ongoing and pushing forward telesurgery versus telementoring as they run up parallel tracks. Even though there's telesurgical mentoring out there already, I think it is important to realize that it is not one size fits all. And there are still so many gaps to address still and questions to answer about telesurgical mentoring. I can certainly tell you, telesurgical mentoring aside, direct surgical mentoring is sometimes hard. The challenge is we are taking, at least residents or folks that have at least some degree of training, and a lot about telesurgical mentoring as applies to guiding to physicians' assistants and medics to do full blown procedures. I think it certainly can be done.

C&CC: Can you delineate what the tools are needed to establish the foundation of telementoring in support of telesurgical robotics?

CAPT Wisbach: You think about the trajectory of the simplest means of telementoring so it could be a cell phone, FaceTime, or some kind of limited imagery over which you can offer guidance to somebody, but is that on official channels and is that reliable? And then, to what depth, can you offer that telemedicine. I would argue that if you start incorporating aspects of telesurgery robotics, the computer assisted aspects of it, then that heightens the telemedicine potential tenfold. So now you have the potential of seeing 3D telestration, seeing the information in depth, very clearly, perhaps having more reliable communication, and then layering in different technology. I would argue that robotic system-based telementoring gives us a platform to add in all computer-assisted surgery, data analysis, and guidance. A cloud-based phone application call MyIntuitive tm, made by the same company that makes the da Vinci system, that allows you as a surgeon to see how long you are taking to do certain steps of a procedure, what instruments you are using, comparing you to averages collected. Maybe you want to take one instrument and use it less than another instrument, or maybe you can refine your steps so you are more efficient. That kind of learning is available on a computer-assisted platform. I think that this computer-assistance adds true power of projecting surgery into the battlefield.

But it is a trajectory and I think it is an important to say that surgical telementoring is just an extension of what we are already doing. You are already telementoring in the field, whether it be a surgery patient or ER patient, ICU patient, or trauma patient. You are basically doing patient care. So, I think it is important to break down the walls of telemedicine and say telemedicine is as a physician or healthcare provider helping a patient who is remotely located. This could be in all kinds of patient care scenarios, again ICU, ER ward in or out of the hospital, in or out of the OR. The construct in a hospital is that you have walls and rooms and only certain providers go into those rooms. Telemedicine changes that. There are no walls, so you can vary around your care, based on the patient, the level of fidelity you have, and level of technology you can apply. In Naval Medical Center San Diego's Virtual Medical Operation Center (VMOC), you have great communication. You have healthcare information, you have access to other specialists, and you can vary your level of communication, either through phone, VTC (spell out), or possibly through a remote console.

LTC Hong: Because of the unique character of MHS physicians, we sometimes end up in a right place with the right opportunity for long enough to develop a robust robotic surgical practice. Certain places you do not develop this as you may be far further away from training. I can clearly see the use of telerobotic surgery within the MHS system, let alone the operational battlefield for medical readiness purposes. We just need to determine what kind of limitations, procedure gaps, and outcomes that would come from telesurgical mentoring in support of telerobotic medicine.

CAPT Wisbach: If you look at robotic surgery and back in 2006-2008 timeframe when the robotic systems were initially being purchased by civilian hospitals, the use case that drove this adoption was the prostatectomy with robotic technique becoming standard of care to avoid open surgery and improving outcomes. What is the catalyst or 'use case' that drives this adoption in operational environments or overseas? For telementoring, a powerful use case example is in a Role 2 setting with an intracranial injury and intracranial bleed with need for intracranial decompression with a burr hole, the local surgeon can remote guidance by a neurosurgeon. The challenge is how often does that happen? What is the high volume, or a high stakes case scenario? The prolonged field care may be a situation where remote expertise assistance is vital as the patient care evolves and may demand telementoring, and maybe telesurgery in the future.

COL Pamplin: I think that we have demonstrated in multiple simulation scenarios the value of telemedicine. We are working on publishing the randomized control data for telemedicine versus no telemedicine during prolonged field care and how it can affect outcomes at least for simulated patients. I think there's very little doubt that telemedicine and telementoring can help deliver better care, especially when the expertise of that care is not otherwise available. How do you get this technology into places in the future is really the next major step/ I think the way that you do that is you grow it small and you keep expanding that type of capability. We start with it in the training and simulation space like we have talked. I think the strategic documents are starting to come into place, and you allow the expectations that come from the clinicians, from the medics, from the community of interest. This type of support is going to be available to them. You can do scenarios that will demonstrate whether a patient will do better or worse with this type of capability. That will allow the decision makers the freedom of maneuver to start putting in the resources necessary for making this type of capability available on a future battlefield. It is still hard to telementor today, it still takes time. Let us make that problem set easier. Let us iterate upon individual problem sets we identify while we are using the technology.

Laurel Ridge Treatment Center has faithfully served the children, adolescents and adults of San Antonio since 1987. Laurel Ridge's story began with the mission of Saving Lives, Healing Families and Creating Hope for individuals and families in South Texas and has done so with excellence and pride; growing and expanding to now have a compliment of over 600 employees.

In 2007, Laurel Ridge began to see the need for private treatment centers to learn more about the issues and challenges facing active duty service members, realizing that the sheer number of those in need of treatment would soon out-pace the then military system's behavioral health capabilities. Laurel Ridge began an effort to come alongside military command and meet the service member's treatment needs with the most cutting edge and evidence based treatment programs available.

2008 birthed Mission Resiliency, the Active Duty Treatment Program at Laurel Ridge. This dedicated Active Duty unit began with ten beds and all patients on the unit were on a military -specific milieu. Mission Resiliency's goal was to keep the military culture strong with this cohort and to provide the best treatment with the least amount of disruption possible while restoring resiliency to the service member. Ten beds soon became 20 beds and within a couple of years, Mission Resiliency's outcomes and evidence-based treatment resulted in a 60 bed dedicated Active Duty military treatment building on the main campus.

Since its inception, Laurel Ridge's Mission Resiliency program has successfully treated thousands of active duty service members struggling with Combat Trauma, PTSD, substance use/abuse issues, suicidal ideation, and other behavioral health conditions.

Mission Resiliency is a multi-modal, multi-disciplinary approach to intervention that addresses the service member and his or her family as a whole. Laurel Ridge utilizes evidence-based treatment programs meeting or exceeding TRICARE standards of care. Furthermore, Mission Resiliency continues to monitor outcomes, ensure fidelity of treatment, and implement the most current treatments available.

Nearly 1 in 4 active duty service members showed signs of a mental health condition, according to a 2014 study in JAMA Psychiatry. Treatment modalities such a Prolonged Exposure and Cognitive Behavioral Therapy in co-occurring anxiety disorders and Substance Use Disorders has resulted in significant improvements with addressing alcohol and drug use.

Laurel Ridge also treats Active Duty Dependants, realizing deployment related symptoms and issues are not limited to the service member who has been deployed. " says Laurel Ridge CEO, Jacob Cuellar, MD. "When one member of the family is deployed, there is a ripple effect of anxiety, shift in responsibility, and a family dynamic that also needs to be addressed."

Laurel Ridge is perfectly positioned to treat both the service member and the family - many of Laurel Ridge's clinical staff and treatment teams are made up of retired military or military spouses. ***"We not only treat these families, we have been these families,"*** says Director of Military Services, Rodney Norman Army (RET). "Many of us know the struggles, know the pain, have come through to the other side, and are perfectly positioned point these wonderful service members and their families to hope."

MAKING BIG MOVES...

Building on its successful outcomes in treating active duty service members, Laurel Ridge celebrated the opening of the Mission Resiliency Active Duty Outpatient Treatment Program in Killeen, Texas in the Spring of 2014. "Laurel Ridge has always responded to the needs of the Community and we are proud to serve whenever and wherever needed," says CEO Cuellar, MD.

In August of 2020, at the height of the Pandemic, Laurel Riddge celebrated another milestone as they expanded their footprint (across from the original campus) with a brand new, dedicated state-of-the-art Mission Resiliency Active Duty Military Treatment Center. This 120 bed Mission Resiliency campus boasts a beautiful gym, dining hall, kitchen and plenty of space for service members to perform daily PT, stay Deployment Resilient and Mission Ready.

"Our goal is not only to treat the combat trauma, the PTSD, the substance use but to actually build a better skill-set for each ADSM so that they are as proficient in processing trauma, stress, and other deployment or active duty related stressors while also maintaining a state of Mission Readiness," says Mission Resiliency Clinical Director, Angela Chavez.

"We are proud to offer the very best Female Only Sexual Trauma program, as well as a program focused on those battling OCD and the complexities of how it intersecs with Trauma," states Director, of Military Services Rodney Norman, USA (Ret).

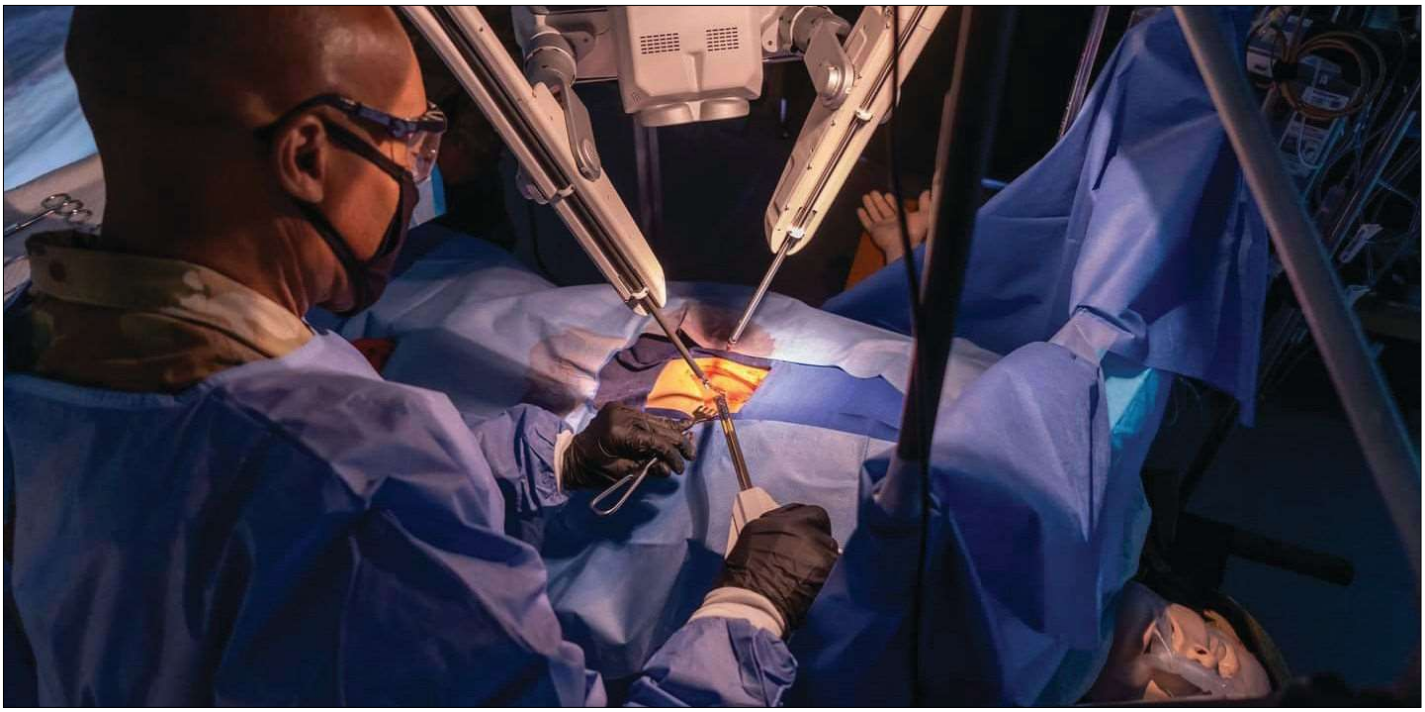
Since its inception, Mission Resiliency's tag line has been: Sometimes You're Between A Rock & A Breakthrough. "That turned out to be almost prophetic," says CEO Jacob Cuellar, MD. ***"Because here, Hope is alive and breakthroughs happen every day. Every. Single. Day... and you know what," he smiles. "We taking it a step further and this year, our focus is to UNLEASH THE BREAKTHROUGH for each servicemember that enters our doors.***

For more information about Mission Resiliency at Laurel Ridge go to laurelridgetc.com or call 210-491-3591.

TELESURGICAL ROBOTICS TO BATTLEFIELD CARE

U.S. Army Telemedicine and Advanced Technology Research Center (TATRC), Ft. Detrick, MD, recently launched its collaborative Telesurgical Robotic Operative Network (TRON) research project to push access to critical surgical capabilities worldwide.

By Mr. Ethan Quist, Deputy Chief MedRAS, TATRC



The Taurus-M Surgical Assist Robot, developed in partnership by TATRC and SRI International, helps in a simulated surgical procedure teleoperated by a remote surgeon using a virtual reality interface. (TATRC)

Telesurgical robotics combines wireless networking and robotic technology to allow surgeons to operate on patients who are distantly located. While the use of telesurgical robotics has advanced significantly in civilian healthcare and the importance of "projecting capability forward with telemetry, telehealth, and robotic surgical capabilities" feature prominently in the Army's future medical concepts for Multi-Domain Operations (MDO), concerns about network latency and safety have limited use of these technologies.

The Army Futures Command Concept for Medical 2028 describes a future operating environment that will challenge medical operations, including a wider dispersion of troops leading to strain on already spread-out medical teams. Additionally, in contrast to past engagements in Iraq and Afghanistan, this future operating concept describes limited windows of air superiority which will cause a delay or even denial of evacuations to fixed hospitals out of theater. And finally, possible large scale combat operations will likely lead to increased amounts of mass casualty situations thus leading to bottlenecking in medical care due to the capacity of current forward care medical teams. For these reasons, the AFC Concept for Medical 2028 describes fixed facility Medical Treatment Facilities as "key enablers… for projecting capability forward with telemetry, telehealth, and robotic surgical capabilities." Surgical robotics, specifically autonomous and semi-autonomous teleoperated robotic platforms can be the answer to providing the enabling capabilities by extending the expertise and assistance of surgeons forward into the battlespace and to the point of need. The goal of TRON was to project surgical expertise, specifically specialized surgeons to the point of need to assist forward deployed general surgeons with critical procedures through tele-assistance and telementoring. But the applications of teleoperated, semi-autonomous, and eventually autonomous surgical robotic systems can have broader effects. By either helping prep, or close out surgeries, robotic systems can help increase the efficiency and therefore effectiveness of a deployed surgeon.

OVERCOMING INITIAL HURDLES THROUGH TRIAL AND COLLABORATION

The Telesurgical Robotic Operative Network, or TRON, research project recently concluded after four years of collaboration between military, university, and industry researchers to advance the cutting edge of telesurgical robotics. This project led to the development of a novel prototype teleoperated robotic surgical platform, fourteen peer reviewed journal publications, and the demonstration of a semi-autonomous vascular repair surgery on live animal tissue. Led by Mr. Nathan Fisher of the Telemedicine and Advanced Technology Research Center (TATRC) and LTC Steven Hong of Walter Reed National Medical Center, the TRON project was a collaboration with SRI International, the University of California San Diego (UCSD), the University of California Berkeley (UCB), and the University of Chicago (UC). SRI International were particularly auspicious partners as they were forefront at the beginnings of robotic surgery as researchers under the initial Defense Advanced Research Projects Agency (DARPA) funded projects in the late 1980's and into the 1990's.

Surgical robotics today are associated with fixed hospital systems, fully resourced operating rooms, and large machinery; however, the

original DoD research calls were for surgical robotic capabilities in extreme environments and the forward battlespace. The TRON project was a return to those initial research goals, ignited by the concurrence of technological advancements in high precision robotic control, progression of global highspeed networking, and cultural and clinical acceptance of surgical robotic platforms. The goals of the TRON project were to identify and characterize the problems caused by signal latency in telesurgical robotics, and to investigate methods that effectively mitigate these problems to provide safe and effective robotic telesurgery. Our approach focused on the design of semi-autonomous robotic surgery protocols and application of machine learning to improve the performance and safety of complex robotic surgical tasks in the setting of time delay and signal disruption. Our hypothesis was that semi-autonomous protocols and applied machine learning are effective countermeasures to improve the safety profile and efficacy of robotic telesurgery against excessive signal latency and signal disruptions.

To accomplish the goals of the TRON project, first we needed to develop a prototype robotic system capable of assisting with battlefield relevant trauma procedures. In December 2020, SRI International delivered to TATRC the Taurus-M surgical robot platform. The original Taurus robot was developed by SRI for a project funded by the Department of Homeland Security to safely diffuse explosive ordinates from a safe distance. SRI designed a small form factor teleoperated robot with a high level of dexterity in the arms and wrists to accomplish complex grasping and maneuvers at the robot's grippers. A remote operator controls the robot through a Virtual Reality (VR) headset, within a virtual digital control room called the Operator Control Unit (OCU). In this design, the VR's hand controllers directly map to robot arm and wrist movements. SRI redesigned the arms of the Taurus robot to equip the Da Vinci Xi line of state-of-the-art surgical robotic tools. The robot arms function as tool adapters, allowing for surgical tools to be hot swapped in and out during operation. This allows for the entire range of the Da Vinci catalog to be used with the Taurus robot, turning it into a surgical Swiss Army Knife. The Taurus-M (medical) as it is now called weighs under 20 lbs. and has a small footprint of 2ft x 2ft. The robot's light weight and compact design is uniquely fit for forward rapid deployment as it is portable, easy to set up and tear down, and draws a relatively low amount of power.

PARTNERING TO ADVANCE APPLICATION METHODOLOGY

The university partners from USCD, UCB, and UC conducted in depth research into advancing the capabilities of the enabling technologies for surgical robotics autonomy, namely the perception and control frameworks. Achievements and publications from UCSD include winning best paper in the category of Healthcare and Medical Robotics at the IEEE Conference for Robotics and Autonomy (ICRA) for their work in real-time tool, suture, and needle tracking for autonomous suturing. The University of Chicago developed advanced anatomy detection algorithms capable of identifying ruptured vessels and segmenting the vessel edges for autonomous robotic grasping. UCB, in investigating methods for surgical robotic autonomy, developed a control framework capable of successfully completing the FLS Peg-Board Challenge, a standardized skills test for laparoscopic surgery, at "superhuman" speeds and accuracies, out-performing surgical residents.

To demonstrate the final integrated Taurus-M platform with a semi-autonomous control framework TATRC conducted animal studies of the robot assisting in temporary vascular shunt placement procedures on live porcine vessels. This procedure was targeted because it represented a battlefield relevant intervention that requires more than one surgeon, and the expertise of a vascular surgeon to complete. We demonstrated our semi-autonomous surgical robotic framework was successful in assisting in a vascular shunt placement procedure even when several seconds of signal latency was induced between the operator and robotic platform, a latency condition that made conventional teleoperation infeasible. The animal study provided a proof of concept demonstration that surgical expertise can be projected forward to the point of need and successfully assist a surgical team despite the deleterious effects of signal latency encountered with the geographic distance between robot and remote expert surgeon.

CONTINUING TO PUSH PROVEN SCIENCE

From this project, the Military Health System now has multiple Taurus-M platforms in the hands of medical research facilities actively engaging in advancing the capabilities of surgeon teams. While full autonomous frameworks is an ongoing long-term goal of the researchers on the TRON team, follow up research is targeting the more near-term possible adoptions of direct teleoperation. The recently initiated follow-on project for TRON is investigating methods such as adaptive motion scaling to mitigate further the effects of dynamic signal latency in far-range teleoperation in both vascular shunt and microvascular anastomosis trials.

EXTENDING PRECISION CARE, PROMOTING CRITICAL INNOVATION

Captain Melissa C. Austin received her initial commission from the Naval Reserve Officer Training Corps Unit at Vanderbilt University in 1996. She was designated a Surface Warfare Officer in 1998.

Capt. Austin completed her first sea tour aboard USS Sacramento (AOE 1) as the Assistant First Lieutenant and Main Propulsion Officer and deployed in support of Operation Southern Watch. She then served as the commissioning Training Department Officer aboard USS O'Kane (DDG 77). She completed a shore tour as a Tri-Command Protocol Officer at HQ NORAD, United States Space Command, and Air Force Space Command, before transitioning to the Selected Reserves and serving as the Training Officer for Commander, Naval Forces Europe Joint Task Force Contingency Unit 118 in anticipation of starting medical school. During this time, she earned a Master's of Basic Science in Biology (Bioinformatics) from the University of Colorado.

Capt. Austin attended medical school under the Health Professions Scholarship Program at the University of Colorado Health Sciences Center. She received her Doctor of Medicine degree and was commissioned as a Lieutenant in the Medical Corps in 2007. After completing a Transitional Internship at the National Naval Medical Center in Bethesda, Maryland, she returned to the surface Navy as the Group Medical Officer for Commander, Naval Surface Group Middle Pacific and Commander, Destroyer Squadron 31 in Pearl Harbor.

Captain Melissa Austin

Director
Walter Reed National Military Medical Center
Bethesda, MD

Combat & Casualty Care had the pleasure of speaking with Captain Melissa Austin, Director, Walter Reed National Military Medical Center (WRNMMC), Bethesda, MD, regarding command efforts to extend the highest level of care to Joint Service personnel and their families via cutting edge capability.

C&CC: What are your primary functions as WRNMMC Director and the Center's main mission goals?

CAPT Austin: Walter Reed provides definitive combat casualty care, sustains the skills of the medical force, trains the next generation of military medical providers, and delivers the highest-quality care to our nation's heroes and their families.

First and foremost, Walter Reed is dedicated to providing top-tier healthcare services to our nation's current and former uniformed personnel, their families, and the broader community. Our hospital is staffed by highly skilled medical professionals and offers a wide range of medical services, from routine primary care to specialized medical and surgical procedures.

Walter Reed is also a hub of medical innovation. Our researchers work on groundbreaking studies, ranging from the development of novel treatment methods and pharmacotherapies to pioneering cutting-edge surgical techniques. This commitment to innovation is central to our mission and underscores our dedication to advancing medical knowledge and practice.

As one of the leading medical centers in the United States, we also have a responsibility to develop the next generation of military medical professionals. Our educational programs are designed to equip our trainees with the latest knowledge and practical experience, ensuring they are well-prepared to face any challenge from the battlefield to the most complex clinical setting.

We have four key goals at Walter Reed:

- We deliver the highest quality, comprehensive care to all beneficiaries. The care we deliver is personalized and holistic, and we consistently innovate, embracing novel therapies and emerging medical technologies to optimize patient outcomes.

- We remain at the cutting edge of combat casualty care, standing ready to receive the wounded, ill, and injured from around the world.
- We offer unmatched training, education, and leadership development for the current and future generations of military medical professionals, ensuring they are equipped with the skills and knowledge needed to excel. We foster an environment where staff can continuously learn, grow, and innovate.
- We collaborate with external partners to share knowledge, and we participate in community outreach programs, recognizing that our responsibilities extend beyond our walls.

C&CC: As the Washington areas largest combined military medical facility, WRNMMC has a responsibility to much more than just this region. What are some of the primary skillsets the Center offers patients, particularly in surgical treatment?

CAPT Austin: Walter Reed National Military Medical Center is dedicated to delivering top-tier medical services, to include surgical treatment. Our commitment to excellence encompasses a diverse range of specialties, ensuring comprehensive care for our patients, regardless of the complexity of their conditions.

Accurate diagnosis is paramount. Our teams utilize the latest diagnostic tools and technologies to precisely identify medical conditions before proceeding with any surgical intervention.

Our meticulous preoperative planning takes into account not only the medical condition of the individual but also their duties and goals of care. We are privileged to serve both active-duty military personnel, retirees, veterans, and their family members.

At Walter Reed we marry surgical skill with innovation. Our surgeons are proficient in both traditional and cutting-edge surgical techniques, guaranteeing optimal outcomes for our patients.

Given our expertise in handling trauma cases, our teams are well-prepared to respond promptly to emergencies, ensuring swift and effective intervention.

From orthopedics to cardiology, neurology to general surgery, our staff offer a complete spectrum of surgical and non-surgical treatments, and we excel in addressing a multitude of medical conditions.

Reconstructive surgeries, particularly for service members who've sustained injuries, are a key focus for us. This includes procedures like skin grafts, burn care, and limb reconstructions, and we emphasize holistic care and rehabilitation for these patients.

We embrace technological advancements, with many of our surgeons incorporating robotic assistance. This enables greater precision, reduced invasion, and often quicker recovery times.

As the Department of Defense's only solid organ transplant center, our transplant teams are skilled in kidney transplants, ensuring comprehensive care for both donors and recipients.

C&CC: From an advances in telesurgical care perspective, speak to some of the latest areas of advancement, particularly from an autonomous/robotic vantage?

CAPT Austin: At Walter Reed, we take immense pride in being on the leading edge of healthcare innovation. Telesurgery, also known as remote surgery, has opened new horizons in the medical field, and we are well on our way to harnessing its potential.

One of the most significant breakthroughs we've achieved is in the realm of robot-assisted surgery. Machines like the da Vinci Surgical System have become routine tools in our operating rooms, where they augment the

precision, vision, and control of our world-class surgeons. This translates into smaller incisions, reduced blood loss, and faster recovery times for our patients.

Our dedication to excellence extends to telemonitoring as well. Thanks to advanced robotic systems equipped with augmented reality overlays, senior surgeons can be virtually "present" in surgeries conducted half a world away. This technology allows for real-time guidance and sharing of expertise, ensuring that even the most complex procedures can be carried out where they are most needed.

Haptic feedback is another remarkable advancement we've embraced. Surgeons operating remotely can now "feel" the tissues they are working on, greatly enhancing precision and safety.

The emergence of 5G technology has been a game-changer, reducing latency and making real-time telesurgical operations not only feasible but also safer. Faster data transfer rates are crucial for high-definition imaging and instant feedback during remote surgeries.

Virtual reality (VR) training has also become an invaluable tool for our surgeons. It allows them to practice and refine their skills in a risk-free environment, ensuring they are fully prepared for real-life surgeries and the complications inherent to them.

Lastly, telesurgery has enhanced our ability to collaborate globally during live surgeries, allowing surgeons to share insights and expertise to ensure the best possible outcomes for our patients.

C&CC: With the continued focus on enhancing techniques in prolonged field care, can you talk to any WRNMMC efforts to support this need?

CAPT Austin: Prolonged Field Care (PFC) is a critical aspect of military medicine, and we are at the vanguard of efforts to enhance survival despite the tyranny of time and distance.

We've recognized the unique demands related to operating in a forward-deployed small-unit setting and have taken proactive steps to equip our medical personnel with specialized training that focuses on preparing medics and Corpsmen for the challenges they may encounter in remote or resource-limited settings. These programs cover everything from basic trauma care to managing infections and complications.

Our institution actively invests in research programs that identify challenges specific to PFC and develop evidence-based solutions. Active areas include novel wound care techniques, assessing and improving the effectiveness of field equipment, and continually refining the principles of medical practice in austere environments.

Walter Reed has developed and deployed advanced mobile medical units that are agile, scalable, and mission tailored. These units allow us to provide a greater range of treatments than ever before, ensuring the wounded receive high-quality care under even the most challenging conditions.

Leveraging advancements in communication technology, Walter Reed is piloting telemedicine initiatives for prolonged field care. This innovative approach allows Corpsmen and Medics in remote locations to consult with specialists at our center in real-time, bridging the expertise gap and enhancing care delivery.

In addition to standard first aid kits, we are pioneering the creation of specialized medical kits tailored specifically for PFC. These kits include tools and supplies that enable more advanced interventions, such as fracture stabilization and airway management, ensuring caregivers have the resources they need to save lives where they are most needed.

Walter Reed actively collaborates with industry leaders to develop tools that deliver the necessary results. These partnerships have resulted in innovative solutions such as portable diagnostic tools and compact surgical instruments that enhance the capabilities of our medical personnel.

Every mission and field intervention serves as a valuable learning opportunity, and Walter Reed encourages all providers to share their experiences, challenges, and insights post-mission. This rapid-cycle feedback loop enables us to continuously refine our approaches to PFC, ensuring that we constantly improve our capabilities.

We believe that training should not be limited to classrooms. That's why we've established simulated field environments where front-line providers can practice their skills in settings that closely mimic real-world challenges. This hands-on experience is invaluable in preparing them to deploy.

C&CC: In terms of post-treatment rehabilitation, particularly from a major surgical standpoint, what are some focal types of care WRNMMC offers?

CAPT Austin: Rehabilitation after major surgery plays a pivotal role in the healing process, and at Walter Reed, we are dedicated to delivering comprehensive and patient-centered care. Our post-treatment rehabilitation services are tailored to the unique needs of everyone.

For example, our team of highly trained physical therapists utilizes advanced techniques to help patients regain strength, mobility, and functionality following surgery. Whether it's assisting someone in build muscle strength after orthopedic surgery or improve mobility after an amputation, we provide personalized care. Our state-of-the-art equipment allows us to simulate real-world challenges that allow patients to not only recover but also prepare for life outside our facility.

Beyond physical recovery, our occupational therapists work diligently to address activities of daily living that patients may struggle with post-surgery. From dressing and eating to more complex skills required for their profession or hobbies, we use real-world scenarios and adaptive tools to help patients regain independence.

For those who have had amputations, our prosthetics department offers cutting-edge prosthetic limbs equipped with the latest technology. These prosthetics offer more natural movement, increased durability, and better integration with the body. Furthermore, our therapists provide comprehensive training to ensure patients can maximize the functionality of their new limbs.

Recognizing the interconnectedness of the mind and body, our holistic approach to healing includes integrative health and wellness services. These therapies, such as acupuncture, meditation, yoga, and nutritional counseling, aim to alleviate pain, manage stress, and improve overall well-being, creating a comprehensive healing experience.

We understand that surgery can bring emotional and mental challenges. To address these aspects of healing, our integrated team of psychologists and counselors offers support through individual counseling and group therapy.

Recovery is not just an individual effort; it's also about community support. That's why we facilitate programs that connect individuals with peers who have undergone similar challenges. These programs provide a space for sharing stories, overcoming challenges, and celebrating triumphs.

Our commitment to rehabilitation doesn't end when patients leave our facility. We provide ongoing care, regularly checking in with patients, adjusting treatment plans, and ensuring they have the necessary support for a full and successful recovery.

Our post-treatment rehabilitation is a testament to our unwavering commitment to our service members and their families. We offer not only medical care but also a holistic environment where individuals can heal, grow, and regain their place in the world with confidence and dignity. Our comprehensive approach to rehabilitation reflects our dedication to supporting those who have made sacrifices in service to their country.

MULTI-ENVIRONMENT MEDICAL EGRESS

SKEDCO, Inc., a leading producer of medical extraction litter equipment, has introduced its Rapid Extraction Sked/Rapid Extraction Sked (Low Profile) for field use.

By Bud Calkin, Founder and General Manager, Skedco Inc.

After creating the first-ever roll-up stretcher, SKEDCO, in coordination with U.S. Army Medical Research Materiel Command (USAMRMC), Ft. Detrick, MD, and the Army's Rescue Litter Modernization initiative, has developed and produced two new smaller and lighter litters.

SAFE AND ACCESSIBLE DESIGN

The Rapid Extraction and Rapid Extraction (Low Profile) litters are 28 and 22. 5 inches wide verses the 36-inch-wide standard Sked. They are designed for all terrain operations, provide easier casualty access, hoistable both horizontal and vertical positions while incorporating a patient harness for patient safety during hoisting operations.

The Rapid Extraction and Rapid Extraction 22. 5 inch (LOW PROFILE) and 28 inch litters (SKEDCO)

PARTNERING FOR LIFESAVING

SKEDCO has provided over 500,000+ Skeds to the U.S. Military and our allies for thousands of medical evacuations since 1987. The Rapid Extraction Skeds consist of the same high-quality materials as other SKEDCO products, and we are excited to be a key player in the Rescue Litter Modernization program.

More info: Skedco.com

TARGETING EFFECT OF THE BLEED

The U.S. Army is testing the latest in pharmaceuticals designed to help prevent hemorrhagic shock, a primary complication experienced by combat medics administering point of injury care.

By Paul Lagasse, USAMRDC

Bin Liu (left), Xiaowu Wu, Ph.D., and Jeffrey Keesee test blood samples using a rotational thromboelastometry, or ROTEM test, to measure blood coagulation. (U.S. Army photo by Dr. Steven Galvan, USAISR)

Hemorrhagic shock, or cellular oxygen deprivation caused by severe blood loss, is the number-one cause of preventable death in combat. The traditional approach to dealing with hemorrhagic shock is to quickly replenish the patient's blood before the loss can jeopardize their survival. However, timely and safe delivery of blood and plasma during far forward combat operations in austere environments is not always feasible or even possible. The Blood and Shock Resuscitation Combat Casualty Care Research Team 1 (CRT1) at the U.S. Army Medical Research and Development Command (USAMRDC) Institute of Surgical Research (USAISR), also known as "ISR," is exploring an innovative alternative to blood replacement – using pharmaceuticals to help injured Warfighters survive longer even when they cannot get a timely transfusion.

An analysis of combat casualties in Operation Iraqi Freedom and Operation Enduring Freedom, as published in the Journal of Trauma and Acute Care Surgery, found that just over 90% of preventable battlefield deaths were the result of hemorrhage. The study authors concluded that the most significant opportunity for improving casualty outcomes was the period before an injured Warfighter could be transported to a medical treatment facility.

"Those data have been a big motivator for my entire program as well as for other research and medical provider programs," said Dr. M. Adam Meledeo, a research scientist with CRT1 who is the antishock research protocol's science lead. "We recognize that there will always be casualties in war, but if you could have prevented even one of them, that hurts. Our goal has been to do everything we can to reduce that number to zero, or as close to it as we can possibly get. And providing blood and hemorrhagic shock control as early as possible is going to provide the lion's share of those reductions in preventable cases."

MEDICS FACE LOGISTICAL CHALLENGES IN BLOOD DELIVERY

When it comes to replenishing lost blood, the ideal replacement is – not surprisingly – more blood. Whole blood is a single product that includes all the necessary elements for survival: plasma, red and white blood cells, and platelets. Supplying each of those components individually increases the logistical burden – not Sonly because each component must be delivered separately, but also because they each have their own storage and thawing requirements, not to mention the need for reliable electrical power to maintain the components until they are ready for use.

Significant progress has been made in the logistics of supplying whole blood to the point of injury, largely through the adoption of the U.S. Joint Trauma System's Tactical Combat Casualty Care guidelines, which recommend the use of stored whole blood for prehospital treatment of battlefield injuries. One way to accomplish that is by using "walking blood banks," or pre-screened donors either on the battlefield or behind the lines who can be called on to provide a blood transfusion on short notice. The DoD's Armed Services Blood Program regularly supplies whole blood from the United States to depots around the world to maintain stocks. From there, medics can take blood into the field using small portable containers capable of storing the blood at the proper temperature, which allows them to return the blood to refrigerated storage rather than discarding it if it was not used.

Despite these and other innovations, however, there is still an upper limit to how long blood can be stored before it becomes unsafe. The U.S. Food and Drug Administration (FDA) has set expiration dates of up to 35 days for stored blood infused with anticoagulants. After that, red cells begin to break down and release potassium and other chemicals that can cause toxic reactions in high enough concentrations. Even unexpired older blood can potentially pose some risk in large enough quantities.

"We know that if we don't find ways to overcome the logistical challenges, then the benefits of whole blood won't be fully realized," remarked Meledeo.

USING PHARMACEUTICALS TO BREAK THE LETHAL TRIAD

To prevent hemorrhagic shock in patients with traumatic injury, medics know they must get the bleeding under control and restore fluids quickly, otherwise the body will succumb to a feedback loop that doctors call the lethal triad: hypothermia, coagulopathy, and metabolic acidosis. Meledeo and his team are zeroing in on the third element of the triad – metabolic acidosis, a condition that arises when insufficient

blood is available to deliver oxygen to the tissues. A byproduct of this so-called anaerobic metabolism is lactic acid, which will eventually lead to multiorgan failure and death if untreated.

Dr. Meledeo, primary investigator Dr. Xiaowu Wu, and their team are investigating a class of pharmaceuticals called prolyl hydroxylase domain inhibitors (PHDIs), which are used to treat anemia in patients with chronic kidney disease. PHDIs work by promoting the formation of a hormone called erythropoietin, which triggers the production of red blood cells. More importantly for their project, PHDIs also prevent the degradation of a molecule called HIF-1α, which helps regulate the body's natural response to hypoxia. Stabilizing HIF-1α enhances the release of lactate from cells and increases the uptake of lactate into the liver, where it can be recycled back to glucose. This helps to slow, and potentially even prevent, the onset of metabolic acidosis.

ISR's Research Director, Col. Andrew Cap, M.S., M.D., Ph.D., FACP, originally proposed investigating PHDIs for the treatment of hemorrhagic shock – an application for which ISR now holds a patent. Incidentally, the scientists who first identified the roles that erythropoietin and HIF-1α play in determining how cells respond to changes in oxygen availability – Dr. William Kaelin Jr., Sir Peter Ratcliffe, FRS, FMedSci and Dr. Gregg Semenza – received the 2019 Nobel Prize in Physiology or Medicine for their discovery.

PILOT STUDIES SHOW PROMISING RESULTS

Three PHDIs are currently available in Japan for treating chronic kidney disease, two of which are undergoing regulatory review in the European Union. To date, only one PHDI has been approved by the FDA. Meledeo's team tested one of these PHDIs in a pilot study. They found that oral administration of a pre-treatment with the PHDI resulted in improvements in blood pressure, mitigated lactate buildup and improved glucose recycling at two and four hours.

Recognizing that prophylactic delivery might not be an ideal method treating for injured and potentially unconscious Warfighters in combat situations, they conducted a second pilot study using an intravenous reformulation given post injury, to more closely approximate actual use cases. They again saw significant lactate mitigation at two and four hours – as well as improved coagulation, which had not been anticipated. Meledeo's team also saw an increase in the messenger ribonucleic acid (mRNA) that is responsible for producing erythropoietin.

"In thinking it through, we're very confident that by mitigating lactate increase, the enzymes that are responsible for clotting are functioning the way they're supposed to," said Meledeo. "And seeing the mRNA go up is a good sign that something is happening there too. Those are nice finds."

After the two pilot studies, the team felt ready to determine the extent to which PHDIs could improve survivability in a lethal hemorrhagic shock scenario. The protocol tested up to 65% blood loss, which if left untreated would result in death within an hour. While injection with a small amount of fluid increased survival from zero to 18% after one hour, the researchers found that PHDI dosage increased the survival rate from zero to 60-70% after one hour.

"At that point, you see the survivability level off without additional deaths," indicated Meledeo. "If they live to an hour and they get blood, they're in good shape."

TARGETING DEPLOYMENT BY DECADE'S END

Dr. Meledeo noted that large animal studies are about to get underway, to be followed in due course by clinical trials on humans. In parallel, ISR has developed Collaborative Research and Development Agreements (CRADAs) with two of the PHDI manufacturers.

"Some of the manufacturers were a little hesitant at first because, honestly, I think they didn't believe that our initial studies were that successful," said Meledeo. "But they're coming around, and with the CRADAs coming into place, we're hopeful that they will be involved in the clinical trial process and FDA approval."

Meledeo foresees PHDIs being deployed two possible ways: a pill that Warfighters can take preventively before going on a mission or into combat, and an intramuscular injection that Warfighters can carry and inject themselves or a buddy if needed. A working group has been established to explore these options and to oversee the planned clinical trials.

"We anticipate this pharmaceutical being available before the end of the decade, but hopefully that's not too pie-in-the-sky," emphasized Meledeo. "Pharmaceutical development is usually a very long process, but we have already made good headway because one of the pharmaceuticals has already been FDA approved, and all of them have gone through safety studies. So, it should just be a matter of answering any questions about the route of delivery and then going into clinical trials to prove the efficacy of the pharmaceutical in this indication."

"I certainly have been around long enough to know not to get too excited too early because, in medical research, things can definitely change," added Meledeo. "But this one is worthy of the sentiment. Something like this does not come along that often."

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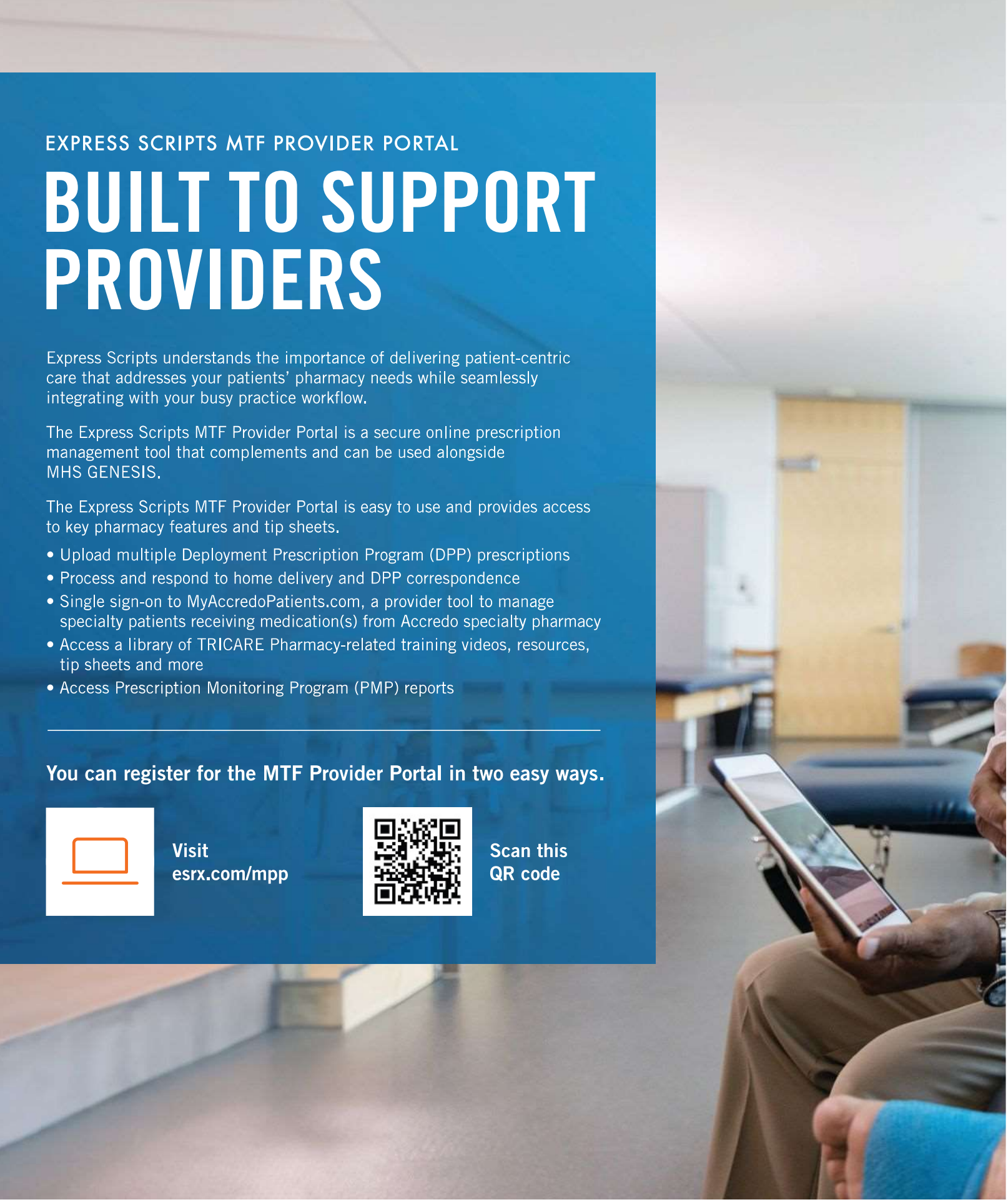

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SIMULATION RELEVANCE TO PROLONGED FIELD CARE CRITICALITY

Changing landscapes of military conflicts require rethinking casualty care for our wounded. Is the U.S. ready?

By LTC (U.S. Army Ret.) Walter Engle, PA-C, Medical Consultant/Medical Trainer

U.S. Soldiers carry a wounded Afghan counterpart to a waiting UH-60 Black Hawk helicopter during a medical evacuation mission at Multinational Base Tarin Kowt in Uruzgan province, Afghanistan, Feb. 20, 2013. The Afghan soldier was flown to the Kandahar Regional Medical Hospital for further treatment. (U.S. Army photo by Sgt. Jessi McCormick/Released)

Medics have what is called a "golden hour' to apply their life-saving skills at the point of injury before handing off to a military field hospital. Unfortunately, that golden hour may turn into Prolonged Casualty Care (PCC) during Large Scale Combat Operation (LSCO) making evacuation of wounded over greater distances more difficult.

"We're worried about future casualties because those distances [to hospitals] are so great," Col. Stacy Shackleford, Trauma Medical Director for the Defense Health Agency (DHA) warned. "If wounded warriors are unable to get that care within the golden hour window of time, Service Combat Medics, Special Operations Medics, and Independent Duty Corpsmen will need a lot of skills, such as administering pain medications, long-term pain control, advanced airway management, and nursing skills like changing dressings, even things like rolling the patient."

DHA Director, LTG Telita Crosland, challenged deployable Forces to prepare for PCC and to increase "return to duty" (RTD) rates on the battlefield as all logistics will be contested in a LSCO environment where there is decreased air superiority for medical evacuation.

ADDRESSING THE NEED TO SIMULATE PROLONGED CARE SCENARIOS

Operative Experience, Inc. (OEI) is an innovator in healthcare simulation and tactical medicine, fielding the Tactical Casualty Care Simulator (TCCS) for all combatant Tactical Combat Casualty Care (TCCC) training in 2017. OEI quickly became the go-to technology for TCCC training among nearly all branches of the military. Answering the call for enhanced PCC readiness, OEI's new Prolonged Casualty Care Simulator Pro (PCCS Pro) meets all 13 guidelines established by the PCC Working Group (WG) for casualty management over a prolonged amount of time in austere, remote, or expeditionary settings, during long-distance movements. As established by the PCC WG, the PCC principles are all executable in training sessions with OEI's PCCS Pro through proposed PCC roles of care recommending:

- Performance of initial lifesaving care and continue resuscitation
- Delineation of roles and responsibilities, including naming a team leader
- Performance of comprehensive physical exam and detailed history with problem list and care plan
- Recording and trending of vital signs
- Performance of teleconsultation as soon as feasible
- Creation of a nursing care plan
- Implementation of a team wake, rest, chow plan to take care of the medic and each first responder
- Anticipation of resupply and electrical issues
- Performance of periodic mini rounds assessments to recognize changes in the patient's condition
- Obtaining and interpretation of lab studies
- Performance necessary surgical procedures, while considering both risks and benefit to the patient's overall outcome and not merely the immediate goal
- Preparation for transportation or evacuation care while ensuring there are ample drugs, fluids, supplies needed for long distance movement
- Preparation documentation for patient handover

OFFERING MODULARITY TARGETING PHYSIOLOGICAL VARIANCE

OEI's unique, modular "Smart Limb" technology with interchangeable limbs and wounds instantly enables trainers to create different injury profiles allowing medical personnel to train correctly to handle the most critical and life-threatening injuries in combat. The PCCS Pro includes advanced physiology and conditions, drug library support, fully integrated patient monitoring, and all-new software capabilities and scenarios. A smart tablet queues up human response in real time based on the type and success of interventions a trainee administers.

Past anatomical deficiency in mannequins produced a negative training experience lowering chances of survival for female service members. Female mannequins designed for both the PCCS Pro and the TCCS are solely based on female anatomy, which is important for trainees in multiple scenarios, such as the triage of a gunshot wound to the chest, treatments of chest seal application and needle decompression. Critical injuries to the chest area are often missed due to hesitancy to completely expose female patients during trauma assessment. Training with accurate anatomical representation is essential to saving lives, it contributes to improved survival and RTD rates on and off the battlefield.

More info: www.operativeexperience.com

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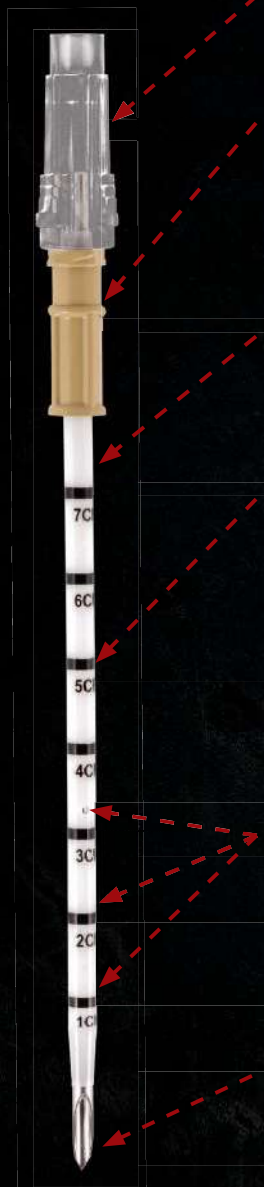

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ANESTHESIA ON THE MOVE

Next-generation technology is extending critical care capabilities in complex or austere deployment environments, addressing key gaps in existing surgical and anesthesia capabilities in combat casualty care.

By Lieutenant Colonel (Retired, US Army) Steven T. Meyer, MSNA, CRNA and Lieutenant Colonel (Retired, US Army) Randall M. Schaefer, DNP, RN, ACNS-BC, CEN

Thornhill Medical's Mobile Anesthesia Delivery Module (MADM™)

As Joint Forces plan for future conflicts and complex missions, military medical care teams will need lighter, stronger, and more portable medical equipment that can withstand austere, extreme, and unpredictable deployment environments.

The Army Futures Command Concept for Medical 2022 and the Army's Medical Modernization Strategy aim to address capability gaps in combat casualty care, including surgical and anesthesia delivery that enable lifesaving surgery at the point of need on the battlefield. What is more, existing capability gaps will be made more acute by temperature extremes, limited power supply availability, and interrupted medication and medical equipment resupply, all of which will impact the effectiveness of anesthesia-provider care. As such anesthesia and its associated equipment must be considered a distinct capability.

A recently published white paper explored the role that next-generation portable anesthesia technology can play in supporting better patient outcomes and warfighter care. Entitled "*MADM™, Mobile Anesthesia Delivery Module, a solution to filling Capabilities Gaps*", the paper explores how Thornhill Medical's MADM™ technology addresses current and future capability gaps and examines the benefits of safe and effective gas anesthesia delivery far forward on the battlefield.

Weighing only 7.1 lbs. (excluding battery) and about the size of an average toaster, MADM™ is an FDA-approved inline gas anesthesia vaporizer which connects to any ventilator device. Portable, adaptable, and quick to set up, MADM™ is lightweight and compact, making it well-suited to challenging environments such as Damage Control Resuscitation and Damage Control Surgery, where time and space are at a premium, and mobility is required.

PROMOTING ECONOMICAL ANESTHETIC CONSUMPTION

While MADM™ can operate with most ventilators, it is particularly effective when deployed in combination with mobile, micro-integrated and multifunction MOVES® SLC™ life support technology. Using the circle-circuit ventilator embedded in the MOVES® SLC™, MADM™ can reuse an anesthetic agent, decreasing consumption. This combination allows for the same functionality as conventional equipment suites but with a much smaller, lighter footprint and the ability to be mounted on the side of a regular litter used by most military units.

Since its initial development with the U.S. Marine Corps (USMC) as a Field Anesthesia System MADM™ has been deployed in critical care scenarios including in Ukraine. It was recently used in conjunction with MOVES® SLC™ in a humanitarian mission involving a U.S. Army Forward Resuscitative and Surgical Detachment.

"Mobility and logistic efficiency will overwhelmingly influence the ability of military medicine to accomplish its mission and save lives. Innovative technologies like MOVES® SLC™ and MADM™ deliver on both mobility and reducing logistic support requirements to allow us to deliver the latest and best technologies for casualty care anywhere, at any time, and to sustain that capability throughout the conflict", explains Vice Admiral (Retired) Dr. Forrest Faison, expert advisor to Thornhill Medical and former Surgeon General of the U.S. Navy.

MADM™ pairs with MOVES® SLC™ for a compact, rapid set-up solution

ENABLING IMPROVED CASUALTY CARE TODAY FOR TOMORROW

As both warfare and combat casualty care continue to evolve, highly adaptable, portable anesthesia solutions will be vital for delivering surgical and extended critical care on or near the battlefront. The mobile, compact, next-generation technology of MADM™ represents a significant step forward in addressing capability gaps and improving warfighter survivability.

More info: thornhillmedical.com/anesthesia

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ALIGNING RESEARCH PATHS TO INTERSECT WITH FUTURE TREATMENT NEEDS

COL Eli Lozano is a native of Los Angeles, California. COL Lozano enlisted into military service in August 1994 as a US Army Healthcare Specialist. He received a Bachelor of Science Degree from the United States Military Academy at West Point in May 2000 and was commissioned as a 2nd Lieutenant in the U.S. Army Medical Service Corps. His professional military education includes the U.S. Air War College, Chief of Staff of the Army Strategic Fellows Program at the University of North Carolina-Chapel Hill, Command & General Staff College, Acquisition Management Course, and Master Fitness Trainer Course. He holds a master's degree in Health Care Administration from Baylor University and a master's degree in Strategic Studies from the U.S. Air War College. COL Lozano's combat service history includes a deployment to Afghanistan as the Medical Platoon Leader of the 1st Battalion, 187th Infantry Regiment, 101st Airborne Division (Air Assault), and a deployment to Iraq as the Executive Officer of the 801st Forward Surgical Team, and Brigade Medical Planner for Task Force Rakkasans, 101st Airborne Division (AASLT). COL Lozano assumed duties as the Commander of Walter Reed Army Institute of Research on August 31, 2023. COL Lozano also serves as the U.S. Army Medical Service Corps Assistant Corps Chief for Administrative Health Services, responsible for facilitating the professional development and policies impacting the largest cohort of MSC Officers, comprising 11 different administrative areas of concentration.

COL Eli Lozano
Commander
Walter Reed Army Institute of Research
Silver Spring, MD

Combat & Casualty Care spoke with WRAIR Commander Eli Lozano regarding current and forward-looking challenges to focusing medical research in areas of prolonged field care and hurdles in areas such as hemorrhage and infection control on a future global battlefield where the tyranny of distance will likely tax the achievement of positive outcomes.

C&CC: As the Commander of WRAIR, what are your primary focus points and command priorities as you support the military services' needs?

COL Lozano: Hola! Let me begin by stating what an amazing privilege it is to Lead an organization with such a dynamic legacy and honored history.

As the WRAIR Commander, my top priority is nested with that of my Commanding General (CG), Brigadier General (BG) Edward Bailey, who leads the U.S. Army Medical Research and Development Command (MRDC) – To ensure that WRAIR research is directly aimed at protecting, preserving, and enhancing our Nation's top weapon system - the American Warfighter! Our Walter Medic Team carries a noteworthy responsibility to assess, research, and deliver timely and relevant therapeutic and materiel solutions that can protect warfighters world-wide. During overseas deployments, our military service members face pathogens, diseases, and environmental conditions that have the potential to degrade our overall readiness, survivability, and ability to maximize combat power where it is most needed. To enable WRAIR's ability to conquer the challenges of today and those of Army 2030/2040, I have prioritized four focus areas: Equipping and inspiring competent, highly trained, military leaders of character with the Soldier skills they need to effectively serve, lead, and deploy world-wide; leader developing our fantastic federal government civilian workforce to serve as the continuity of our research programs to ensure we codify enduring organizational research practices; reorienting WRAIR research efforts to better nest with emerging DoD requirements; and realigning our overseas research activities to support Combatant Command engagement strategies, which we accomplish through our strategic partnerships with U.S. State Department, Partner Nations, and Industry.

C&CC: The Army formally announced the 2030/2040 initiative last year. This initiative will modernize the force by ensuring our adversaries cannot outrange or outpace us on the battlefield. Can you explain how current WRAIR research contributes to this transformation?

COL Lozano: The future battlefield will involve dispersed formations operating in challenging environments that demand discipline and resilience. Our Soldiers will have to closely monitor invisible threats that can take them out of the fight. Our military history illustrates that nonbattle disease injuries constitute a significant portion of military theater casualties – the future fight in large scale combat operations (LSCO) will be no different. WRAIR is pursuing initiatives that tackle endemic infectious diseases, brain health, and Soldier performance to keep soldiers strong and mission focused. As an example, WRAIR is testing a sleep headband that augments restorative sleep and maximizes performance for the limited sleep battlefield in which our Soldiers may find themselves. Our brain health researchers are developing tools and training that promote peer-based interventions that will keep our Soldiers in the fight.

The future operating environment will involve delays in medical treatment and evacuation consistent with a contested space, and will demand innovative solutions to maximize return-to-duty and Soldier survivability. We aim to minimize warfighter death and disability by contributing to MRDC efforts toward a "smart bandage" approach that incorporates the best available technology for wound management, including hemostatics, analgesics and anti-infectives. Other efforts include studying the science of traumatic injury and post-traumatic infection to better understand how to address the altered physiology and immunosuppression of wounded Soldiers, and inform clinical practice guidelines for managing these soldiers and their wounds.

C&CC: In terms of infection mitigation as relates to surgical application, what are some of WRAIR's focal efforts that are helping advance the transition of research to live implementation?

COL Lozano: In previous conflicts, such as Operation Iraqi Freedom and Operation Enduring Freedom, we could evacuate our Warfighters in less than 60 minutes. This meant that we could provide early and effective wound management, which reduced complications like wound infection and limb amputation. However, even in these ideal conditions, infection rates of large extremity injuries were approximately 30 percent.

In a LSCO conflict with near-peer adversaries, we don't expect to have air superiority that enables rapid medical evacuation, won't have a surplus in medical treatment and hospitalization capacity, and will be faced with contested medical logistics and challenges with wound management and infection prevention. Given this complex scenario characterized by stunted capabilities, any novel debridement techniques, irrigation solutions, anti-infectives and wound coverage must stabilize tissue and reduce infection to prevent the loss of limb or life. WRAIR researchers are testing experimental and commercially available materials and working with MRDC and extramural partners to evaluate treatments to ensure our warfighters get the best available care they require in battlefields of the future.

C&CC: In terms of infection mitigation as relates to surgical application, what are some of WRAIR's focal efforts that are helping advance the transition of research to live implementation?

COL Lozano: Our current Assistant Secretary of Defense for Health Affairs recently stated at a DoD Military Research Symposium that WRAIR's forward locations are the gems of the Department of Defense and our Country! He is absolutely right! These forward-stationed labs are our DoD's strategic research and disease surveillance hubs that support military force readiness and facilitate cooperation with our allies and partners. Through the efforts of our overseas footprints, we have kept warfighters safe by fielding products that also protect the local populations in our partner nations. Our Japanese Encephalitis and Hepatitis A clinical trials conducted at AFRIMS contributed to product licensure and fielding in support of INDOPACOM. Our MRD-A infectious disease surveillance network enables USAFRICOM AOR by informing force health protection planning for our forces, Africa host nation partners, and international public health agencies. MRD-G's work across the EUCOM AOR has greatly facilitated the identification of highly contagious antibiotic-resistant bacteria that pose potential, severe health threats for our Military Health System. MRD-West at Joint-Base Lewis McChord maximizes Warfighter health and performance by working in conjunction with JBLM operational force organizations to identify physiological, psychological, medical, and environmental hazards that stress Soldier physical, cognitive, and psychological capacities. Increasing Soldier readiness, resilience, and recovery are vital for winning decisively on the battlefield.

C&CC: Can you speak to any innovative research WRAIR is doing in the brain health fields to prepare Soldiers and servicemembers for the future battlefield?

COL Lozano: Warfighters in combat face challenging and stressful situations. Our research shows that during combat it is not unusual for Service Members to encounter teammates experiencing acute stress reactions. In one survey, 45% of Soldiers reported witnessing a team member exhibit acute stress that rendered that individual temporarily inoperative. During LSCO conflicts, acute stress reactions are likely to increase, and as such, potentially compromise overall unit effectiveness. To address acute stress reactions, our behavior health researchers have developed peer-to-peer tools, such as iCOVER, SMART and Warrior Mindset, that can help service members manage acute stress symptoms in their Brothers and Sisters in-arms. These techniques can be used in the heat of the moment to focus attention, regulate emotion, maintain composure, and stay motivated in daunting environments.

C&CC: As WRAIR's first Latino American commander, who were your mentors and how has their advice shaped your understanding of WRAIR's important medical research and application?

COL Lozano: I can tell you that I feel incredibly honored and privileged to represent all Latino Americans that proudly serve in the world's most honorable Military. For millions of Latinos serving in our communities across the nation, we truly stand on the shoulders of giants – our Parents and Grandparents that migrated north so that our current generations could live the American Dream and give back to the greatest country in the world.

Wow, my mentors?! I've had a multitude of mentors throughout my career that invested countless hours of time, patience and wisdom so that I could become a Servant Leader worth following. The current Defense Health Agency and Army Medicine Senior Leaders have emphasized to me the importance of ensuring that WRAIR continues to focus its research proposal efforts on our DoD's most relevant and pressing operational gaps. Military Medicine has the critical role to conserve the fighting strength of our deployed operational forces. The MRDC CG, BG Bailey, has outlined a thoughtful, inspiring vision that empowers WRAIR to leverage the capabilities of the Joint Force and optimize our partnerships in the corporate and academic sectors to facilitate innovative and dynamic solutions in support of our amazing warfighters.

DELIVERING MEDICAL MATERIEL IN SUPPORT OF WORLD-CLASS CARE

COL Andy Nuce currently commands the U.S. Army Medical Materiel Development Activity and serves as the Medical Acquisition Consultant to The Surgeon General and the Army Medical Department Acquisition Career Management Advocate. COL Nuce began his military career as Platoon Leader, Bravo Company, 147th Medical Logistics Battalion (Rear), Fort Sam Houston, Texas. His other assignments include serving as Chief of Logistics, Medical Element, Joint Task Force Bravo, Soto Cano Air Force Base, Honduras; 147th Accountable Officer for Class VIII, Fort Hood, Texas; Chief of Materiel and PROFIS Company Commander, Evans Army Community Hospital and A Company, 172nd Medical Battalion (LOG), Operation Iraqi Freedom; Property Book Officer for HHC, 30th Medical Brigade, Heidelberg, Germany and Baghdad, Iraq (in support of Operation Iraqi Freedom); Support Operations Officer and Company Commander for A Company, 226th Medical Logistics Battalion, Germany and Iraq; Assistant Product Manager, Medical Communications for Combat Casualty Care, Fort Detrick, Maryland; Deputy Commander for Operations, U.S. Army Medical Materiel Center–Korea, Camp Carroll; Executive Officer, 168th Multifunctional Medical Battalion, Camp Walker, Korea; Medical Acquisitions Officer, U.S. Special Operations Command, MacDill AFB, Florida; Commander, Troop Battalion, Tripler Army Medical Center, Hawaii; and Division Chief, Department of Leader Training, U.S. Army Medical Center of Excellence, Fort Sam Houston, Texas.

COL James A. (Andy) Nuce
Commander
U.S. Army Medical Materiel Development Activity
Fort Detrick, MD

Combat & Casualty Care recently spoke with COL Andy Nuce, Commander of USAMMDA, about his organization's role as the Department of Defense's advanced developer for medical products to protect Warfighter health and enhance readiness.

C&CC: Please describe USAMMDA's role in the development of medical materiel to protect Warfighters.

COL Nuce: The U.S. Army Medical Materiel Development Activity (USAMMDA) develops, delivers, and fields critical drugs, vaccines, biologics, devices, and medical support equipment to enhance readiness, ensure provision of the highest quality medical care to the Department of Defense (DoD), and maximize survival of casualties on the battlefield. We are the primary medical product development, systems management, and acquisition organization within DoD.

Our project managers guide the development of medical products for the U.S. Army Medical Department, other U.S. Services, the Joint Staff, the Defense Health Agency (DHA), and the U.S. Special Forces community. The process takes promising potential military technology from DoD, industry, and academia through the testing required for U.S. Food and Drug Administration (FDA) approval or licensing, all the way to fielding and sustainment of the finished product.

USAMMDA was initially established in 1985 to serve as the Army's medical materiel developer. Over the years, however, that mission has expanded to protecting and serving all branches of the U.S. military, as demonstrated by our ongoing organizational transition to DHA.

C&CC: What are your organization's top priorities, and how do they align with Army and DoD priorities?

COL Nuce: Army medicine has shifted its focus during the past several years, from sustaining combat operations during the wars in Afghanistan and Iraq, to modernizing the medical technologies and treatments the U.S. Joint Force will require during operations

in contested regions in the Indo-Pacific and Arctic regions. Future conflicts are expected to include dispersed operations, with logistics and supply lines stretching across hundreds, or even thousands, of miles.

To meet these challenges, USAMMDA and our partner organizations under the U.S. Army Medical Research and Development Command (USAMRDC) and the Army Medical Command (MEDCOM) are developing devices, treatments, and technologies for military health care providers at and near the front line.

Working with combat developers to define gaps and requirements, our Project Management Offices (PMOs) collaborate with partners in DoD laboratories, academia, industry partners (both nationally and internationally), and other government agencies to develop products to support Warfighter health and performance across the continuum of care.

C&CC: Could you address materiel development targeting surgical medicine in particular?

COL Nuce: The latest innovation is the incorporation of portable CT scanners designed for field deployment. These scanners are engineered to function in harsh and resource-limited settings, providing crucial diagnostic imaging closer to the point of injury. This technology allows for rapid and accurate assessment of internal injuries, which is vital for surgical planning and intervention. USAMMDA continues to field CT scanners to the force, while training biomedical equipment technicians and operators to ensure personnel are prepared for operational use, benefits, and maintenance protocols of the CT scanning systems.

USAMMDA's Warfighter Expeditionary Medicine and Treatment PMO leads the development and fielding of FDA-cleared or approved medical devices, drugs, and biologics that fulfill unmet requirements identified by military capability developers or end users. Several of our current focus areas support surgical medicine, including hemorrhage detection and control, extremity injury repair, multi-organ support, and oxygen supply and generation.

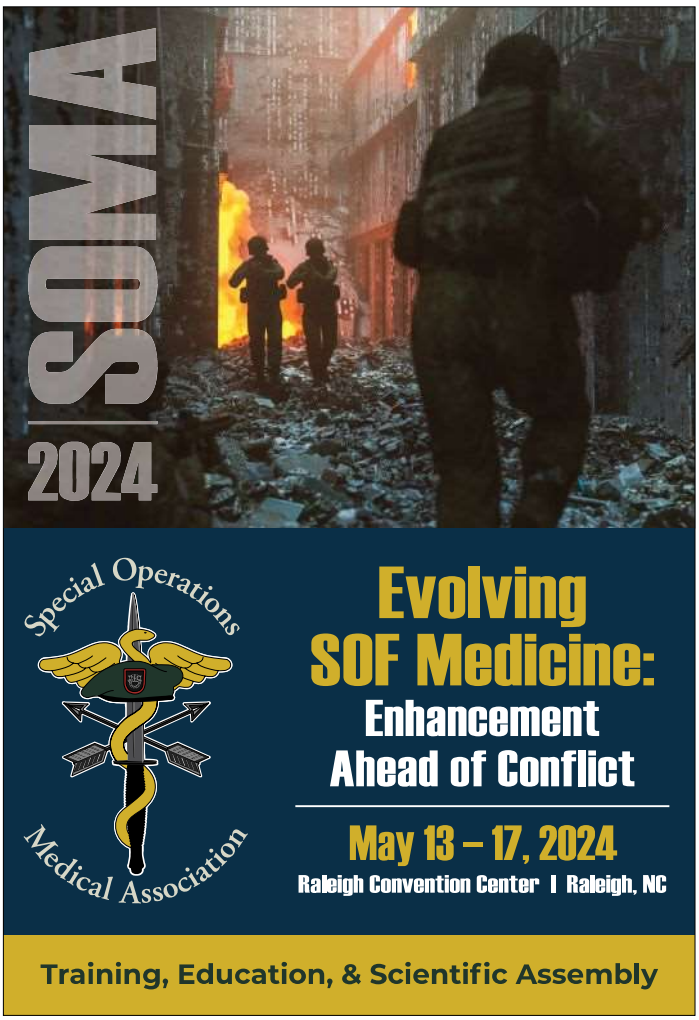
One example is the new Expeditionary Deployable Oxygen Concentration System (EDOCS). Built for military use in austere environments, EDOCS is a commercially produced oxygen-generation unit that takes in ambient air and produces approximately 93 percent medical grade oxygen. It can be used in the field to provide oxygen to medical treatment facilities. To prepare for the Army's 2024 fielding of EDOCS, USAMMDA coordinated operational and service training in September 2023 to allow Army Medical Logistics Command team members to learn more about the system and its maintenance requirements.

C&CC: How will the products USAMMDA is developing today support the battlefield of the future?

COL Nuce: Blood and blood products are critical to multi-domain operations for humans and canines, and USAMMDA is developing several solutions to treat massive blood loss and improve patient survival far forward on the battlefield. Our portfolio includes freeze-dried plasma, cold-stored platelets, and cryo-preserved platelets to extend the shelf life of these life-saving blood components. We are also developing resuscitation fluids and hemoglobin-based oxygen carriers (HBOCs). Fluid resuscitation is a vital treatment in the care of hypotensive trauma patients to diminish the effects of shock at the cellular and organ level, while HBOCs can potentially provide therapeutic oxygenation when whole blood or red blood cells are not available.

USAMMDA partnered with Army deployed units and medical treatment facilities to assess a point of use blood test for mild traumatic brain injury (TBI), which was developed in partnership with industry and cleared by the FDA in 2021. This first-ever TBI blood test on a hand-held, deployable device may help avoid unnecessary evacuations and computed tomography (CT) scans among Service members. In addition, data from Level I trauma centers throughout the U.S. demonstrates that the test could serve as a triage tool to help clinicians manage more severe head trauma cases.

Our Force Health Protection Division develops and manages protocols for biological threats, whether they are naturally occurring or deliberately released. We rapidly provide investigational medical countermeasures for the Warfighter and can manage interim fielding of promising Investigational New Drug (IND) products until they have been licensed by the FDA. One recent example that will likely be familiar to your readers is Remdesivir, the drug used to treat COVID-19.



CALENDAR OF EVENTS

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

FEB 12 – 15
AMSUS
National Harbor, MD
Amsus.org

MAR 13 – 14
Deployed Medical & Healthcare Delivery
London, UK
Defenseiq.com/events

MAR 25 – 26
OPMED
San Antonio, TX
Operationalmed.com

APR 8 – 12
Military Health System
Portland, OR
Mhsconference.com

APR 30 – MAY 2
Modern Day Marine
Washington, DC
Moderndaymarine.com

MAY 6 – 10
SOF Week
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Sofweek.org

MAY 13 – 17
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