TATRC TIMES

SPECIAL EDITION AUGUST 2023

A QUARTERLY PUBLICATION OF THE
TELEMEDICINE & ADVANCED TECHNOLOGY RESEARCH CENTER

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Commander's Corner: TATRC's Plan for Automating Casualty Care

COL Jeremy C. Pamplin,
TATRC Commander

The last TATRC Times was officially published almost 12 months ago, so it's been a while since we've had an opportunity to publicly share our story and perspective on how we are doing and where we are going.

A lot has been going on over the past year! Most importantly, we've been working with our strategic leaders at USAMRDC, our friends at the Medical Capability Development Integration Directorate (MED CDID), stakeholders across the Defense Health Agency (DHA), and our community of partners across the DoD, industry, and academia, to truly define TATRC's roles and responsibilities as the newest command at MRDC. Overall, I am happy to report that TATRC is well positioned and excited to take these on.

So, what are these new roles and responsibilities? TATRC's mission is automating casualty care by fusing data, humans and machines into trustworthy solutions that optimize medical performance and casualty outcomes by reducing the human burden of casualty care and maximizing the capability and capacity of the Military Health System across the continuum of care.

In short, our future vision is fully autonomous casualty care – a concept that is certainly not achievable in our lifetime, and potentially impossible to fully achieve. Nevertheless, the journey toward fully autonomous care from where we are today, in which medical care is 100% in the human domain, will produce novel human-technology teaming (HTT) solutions that will:

- Reduce human task burden. When machines perform basic tasks that are simple, manual, and don't require human judgement, we can free humans from a percentage of task and give them more time to do other activities, thus increasing capacity. Examples include documenting patient care, moving patients from A to B locations, monitoring vital signs and mental status, adjusting IV pumps and ventilators, and tracking and automatically re-ordering resources as needed, etc.

- Make better decisions faster. Faster, more accurate decision making at echelon – from the "bedside" across the care continuum and at C2, evacuation, and logistics nodes – will further increase system capacity by prioritizing activities and making care more efficient. For example, clinical decision support tools will help medically trained and untrained caregivers be more capable of managing illness and injury at the lowest level, and evacuation algorithms will help determine the optimal path for moving casualties.

One foundational challenge with automating casualty care is our lack of real-time data from the point of care… the patient's "bedside," wherever that may be. Unfortunately, this is not the only key challenge: also problematic is the lack of an ecosystem that promotes automation. For comparison, consider the journey of autonomously driving vehicles to that of autonomous casualty care (Figure 1). Autonomous vehicles, still in their infancy, have certain advantages towards automation: they drive in an environment that is highly standardized with consistent labels like road signs, lane markings, light signals; they collect megabytes of data every second from dozens of sensors; they have well-made maps and location services that clearly define the beginning and known ending (i.e. outcome) for each trip; well understood rules and physical properties that produce the same results every time a task is executed to standard; and their data-producing-parts are interchangeable because they are interoperable, producing data according to common standards that do not change from device to device.

In comparison, medicine, has few sensors or standards, produces variable outcomes, even with the same interventions. The densest data space known to medicine, the intensive care unit (ICU), produces a mere hundreds of kilobits per minute (in fact, the entire Joint Trauma System contains less than 400 MB of data). Perhaps most importantly, medicine is hindered by a culture that is averse to humans being watched by sensors during patient care, to trusting technologies, and to automating most aspects of care.

Fortunately, other professions have traveled some of these paths before us. Consider policing: when body cameras were first introduced, many police were concerned that video would identify their flaws and place that at increased risk of judgement and prosecution. The experience however has been much different. Most evidence from body cameras vindicate police

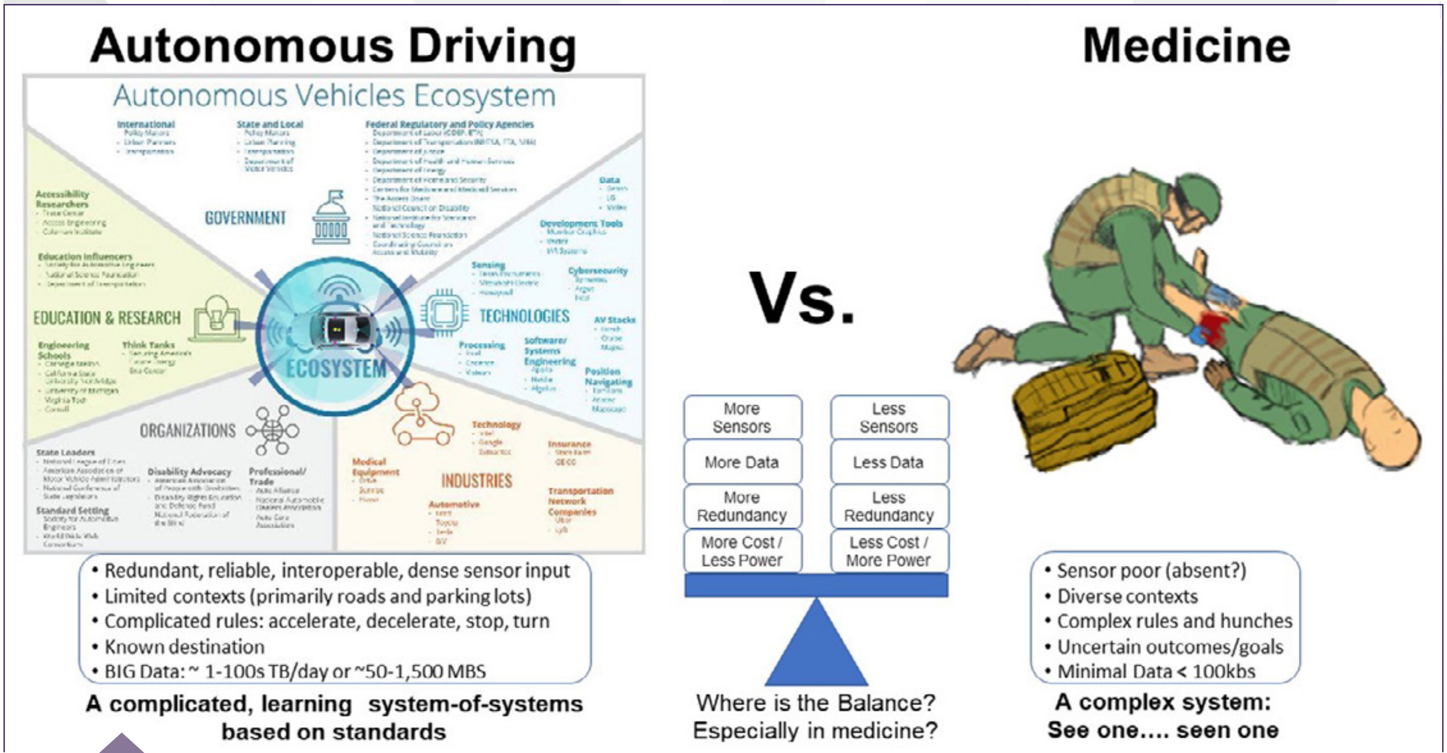

Figure 1: Problem Comparison for Automating Healthcare

actions as being professional, ethical, and appropriate (although in fairness, they have also exposed systemic flaws in training and education that must be addressed appropriately). Ultimately, the data has helped identify opportunities for improvement and refine priorities for addressing them. Automation of commercial air-travel has made flying consistently safe and more comfortable. Modeling and novel data representation have enhanced decision making for disaster management related to hurricane response.

We imagine a future in medicine where sensors that are integrated in the clinical environment passively, accurately, reliably, and consistently collect data in real-time about the casualty's status, caregiver's actions, and their use of resources. With this information, we can start to better understand how to prioritize solutions that will improve casualty care and can develop solutions that remove tasks from the caregiver and increase their opportunities to spend the right amount of time with the right casualties.

All autonomous systems utilize an OODA loop to make decisions and produce action. The OODA loop - observe, orient, decide, and act - is a continuous process that caregivers implement for all patients: assessment, decision making, treatment in the context of resources available and synchronized within the available system of care. Again, if we relate this to a vehicle, cruise control is an example of an automated task that relieves a human driver of the task of maintaining speed. Furthermore, in today's cars, cruise control adjusts to the environment around it by maintaining a specific distance to the car in front of it. The technology necessary to deliver that task begins with the car perceiving its speed and the distance from the car in front of it. The technology then interprets that speed as being faster or slower than the desired speed, decides to add gas or take it away and ultimately, utilizes all of the hardware necessary to execute the task of increasing the speed or braking as needed to achieve the desired outcome.

To develop such an autonomous system requires an Automation Stack (AI Stack) (Figure 2). The AI Stack begins with a perception layer built upon devices and sensors that passively collect data about context, state, and activities. It is followed by an understanding layer or learning layer that interprets this data and makes sense of it. This information can then be used to make or support many decisions at all echelons of patient care.

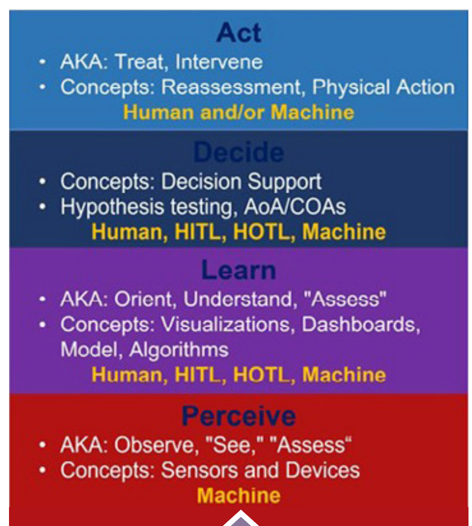

Figure 2: Automation Stack (AI Stack)

Finally, we can use that information to make decisions faster or to offload certain decisions and tasks to machines. This requires robotics, manufacturing, and human-machine interfaces. Ultimately, the creation of human technology teams will change the way we deliver patient care across the care continuum, affecting all aspects of doctrine, organization, training, materiel, leadership and education, personnel, facilities, and police (DOT MIL PFP). Importantly, however, automation cannot start with the decision or action layer as both require the perception and understanding layers to execute the correct decision and thus action.

PROJECT 1: Passive data collection and autonomous documentation – the "AutoDoc Project."

The first necessary step for creating autonomous solutions is producing data. At present, there is a paucity of data from combat casualty care and to produce it require humans to document what they see and what they do for casualties. Consequently, TATRC's first project within our new mission space, is passive data collection to autonomously document casualty care from the pre-hospital environment (Point of Injury to Role 1 care – if we can "do it here, we can do it anywhere!") in a digital DD Form 1380 or tactical combat casualty care card (Figure 3). Notably, this data set will be foundational. While the first solution we have been asked to address is documentation (an important challenge for all clinicians in any care environment but especially in the pre-hospital setting), the same data can be used for multiple other purposes like developing precision logistics algorithms, enhanced triage algorithms, and prioritized evacuation algorithms amongst others.

This Autonomous Documentation project is intended to be disruptive in nature. Traditionally, military requirements dictate that we must build solutions to fill identified gaps and match pre-specified requirements. In this context, there is no requirement for automation, or for passive data collection. Both of these concepts are enabling technologies that help create solutions to multiple gaps and defined requirement… better than current solutions. Furthermore, this portfolio of work aims to disrupt the traditionally siloed approach to solution development by breaking the connection between data-and-proprietary solution. Traditionally, we define a requirement and fund siloed solution development that often necessitates the collection of specific data from a specific location or context. To collect this data, performers must produce sensors that collect the data their solution requires to function. We spend significant resources developing dedicated (often proprietary) sensor-to-solution pathways (Figure 4 – Blue Box at top).

In this project, TATRC intends to separate the spaces of data collection, data management, and solution delivery. In the yellow section of Figure 4, we intend to rapidly acquire and rapidly deliver sensor suites through a combined intramural and extramural competition that will produce data about casualty care according to a common data model decided upon by the team of performers. Having the performers define this data model – rather than defining it a priori – commits the performers and their engineers to adherence to this model. Importantly, sensor suits must be usable during real-casualty care and cannot interfere with it. In parallel, we will accelerate the development of the data infrastructure necessary to receive data collected from sensor-suites, transfer it to a storage environment, normalize any data that does not fit the data model, annotate the data, curate it as needed, analyze, model it, and share it with others. In the

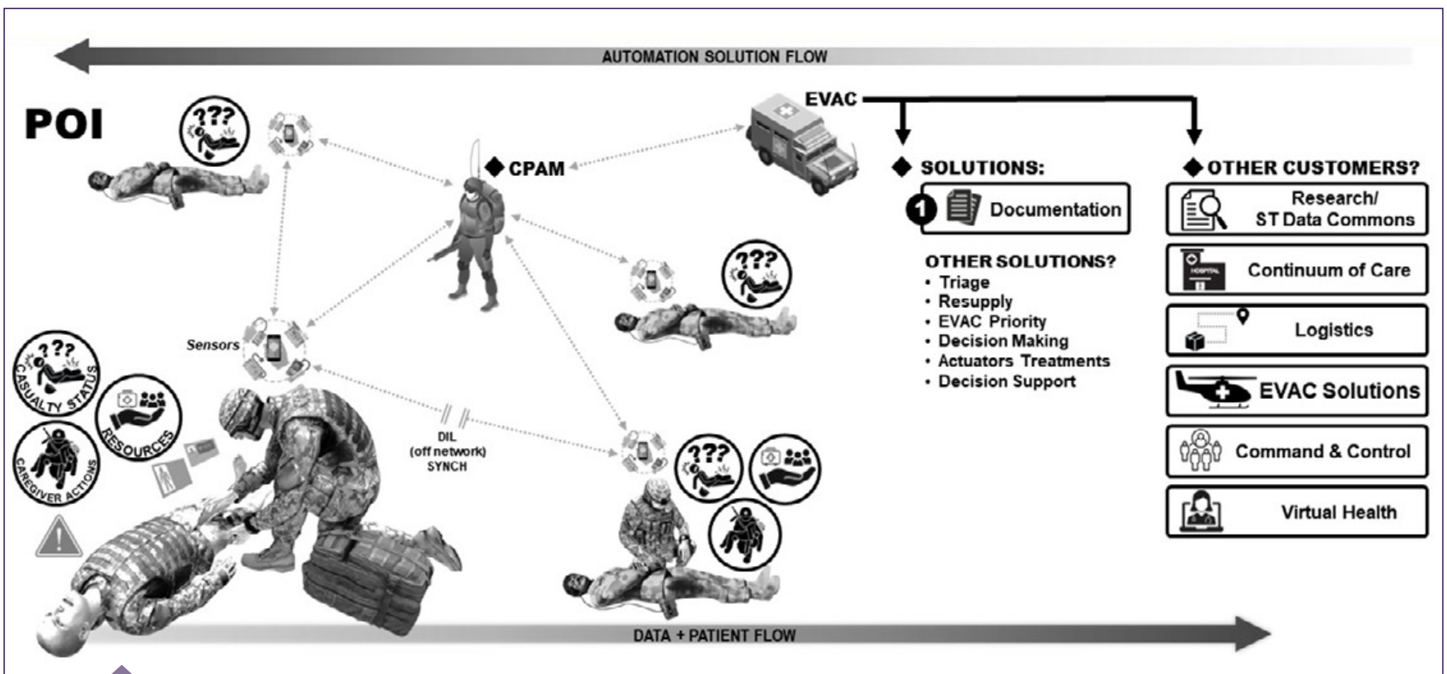

Figure 3: Passive data collection to autonomously document casualty care from the pre-hospital environment.

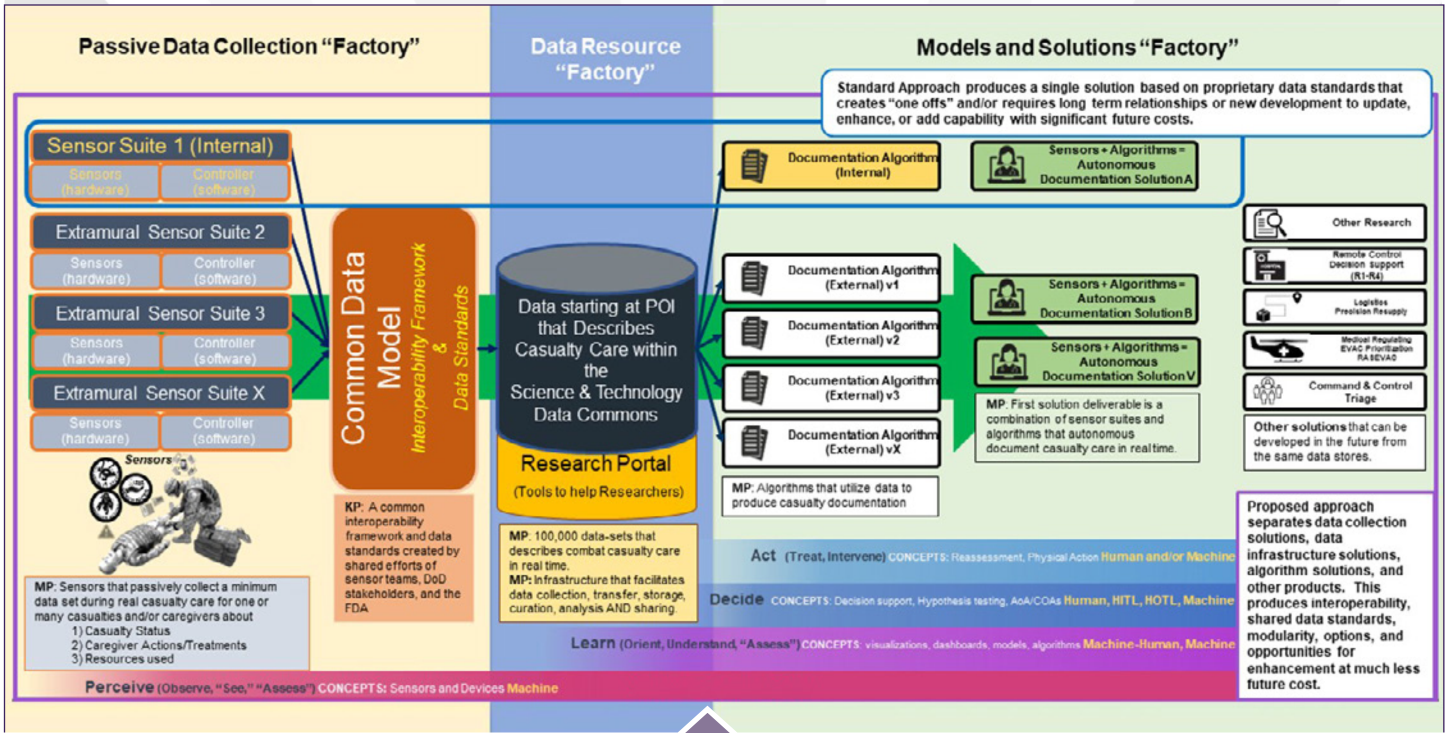

Figure 4: CONOPS: Passive Data Collection and Autonomous Documentation Portfolio

third effort, we will again conduct an intramural and extramural competitive process for developing algorithms and software that autonomously completes (or perhaps, due to legal considerations, recommends documentation to a human for final approval) the Tactical Combat Casualty Care Card (DD1380).

This new paradigm for competitive development with common goals was tested as part of our COVID-19 work to develop the National Emergency Tele-Critical Care Network (NETCCN) and interoperable remote controlled medical devices, including ventilators and IV pumps, for managing critically ill patients. We expect that this new paradigm will produce data that is accessible for other stakeholders and partners to produce needed solutions that will more rapidly modernize military medicine to address the challenges faced in future combat operations.

Our timeline is aggressive. We expect to deliver products every six months – first sensors, then data, then refined sensors and algorithms. Starting this fall, we will execute a competitive down select process to deliver three to six different sensor suites that can accurately and reliably collect data from combat casualty care "under a bush," without interfering with the delivery of medical care.

In the second six-month phase of our project, with help from our partners, we will collect 100,000 casualty care scenarios from laboratory, training, and experimentation events.

As we go into the third six-month sprint, we will continue to collect data at scale and share it with data science teams who will then compete in a second down-selection process by demonstrating their ability to produce algorithms and software that can complete a digital TC3 card.

In the last six-months of this project (yes, within 2 years!), we intend to evaluate the value of our passive data collection and autonomous documentation solutions by increasing the data produced per casualty care encounter while simultaneously increasing the time that caregivers spend managing casualties.
This ambitious effort has been shouldered by the entire TATRC organization, which has realigned itself into functional teams with matrixed work and by the implementation of objectives and key results (OKRs). Indeed, OKRs are proving to be one of the best methods we have identified for holding ourselves accountable to the priority work that must be accomplished.

We appreciate the support we've had from the community of stakeholders including the Joint Trauma System, BATDOK, JOMIS, PEO EIDS, MEDCDID, FFRDCs MITRE and MIT Lincoln Labs, the UARC John's Hopkins APL, and of course, the entire MRDC community and HQ team.

I personally want to thank all of team TATRC for their hard work, initiative, dedication, teamwork, and determination as we take on this new portfolio of work and demonstrate how a paradigm of radical inclusiveness with competition can more rapidly deliver solutions to the battlefield and to our Warfighters.

TATRC's Most Notable Highlights for FY23

It has been quite a fast-paced and busy year for team TATRC! While the focus of this Special Edition of the TATRC Times is to introduce our new mission to automate casualty care, we'd be remised if we didn't share and recap our most notable highlights from this past fiscal year. Here's a quick look from our "highlight reel."

Back in March 2023, TATRC's Deputy Commander, COL Sharon Rosser was officially promoted to Colonel! The ceremony was held at the Military Women's Memorial, and hosted by the Director of the Defense Health Agency, and COL Rosser's mentor, Lieutenant General Telita Crosland.

November 2022

TATRC's Medical Modeling, Simulation, Informatics and Visualization (MMSIV) Division and our Medical Robotics and Autonomous Systems (MedRAS) Division were selected to participate in the U.S. Army's Project Convergence (PC22) experimentation event at Fort Irwin, CA. Our MMSIV team developed the use case & conducted a comparative effectiveness assessment of the technologies participating in the PC22 experimentation & developed 38 patient scenarios that were used as the medical use case scenarios from POI – Role 2 care during the PC22 exercise. The technologies that were specifically evaluated were: CRIMSON, Tempus Pro and NETCCN WICKR.

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TATRC's Deputy Commander, COL Sharon Rosser was named to 2022's G2Xchange Leading for Impact "Women in Leadership" Award Winners from FedHealthIT! At the 5th annual conference, COL Rosser also had the privilege of being invited to serve as one of the keynote panelists for the ceremony. Her wealth of knowledge, contributions to Military Health and cutting-edge leadership were on full display during the panel. Upon receiving the award, COL said, "It is truly an honor to be recognized amongst this group of amazing and inspirational women! I am blessed to have the opportunity to serve and lead with Team TATRC!"

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TATRC held a live demonstration with the Device Interoperability and Autonomy Coordinating Center (DIACC) in mid-November showcasing the work of Medical Device Autonomy and Data Interoperability in Support of Multi-Domain Operations (MDO) of remote control ventilators, monitors and IV pumps. TATRC and an ecosystem of partners, demonstrated the use of medical devices, telemedicine, data analytics, and visualization technologies working together using open standards to illustrate medical device autonomy and data interoperability in support of MDO and military / civilian disaster events such as hurricanes or pandemic surges. Building on last year's December 2021 demonstration of remote control of ventilators and infusion pumps to support disaster care and other previous demonstrations, this demonstration focused on medical device autonomy and data interoperability. The live demos and the event overall was a wonderful success! Congratulations to all who were involved in this demonstration!

December 2022

TATRC's Science Director, Mr. Matt Quinn was inducted into the FedHealthIT Top 100 Hall of Fame as a "Technology Disrupter" in the BEST sense! We are so proud of Matt, for his numerous contributions as he continues to set the bar for innovation and 'outside-the-box' thinking among his peers in the Science community.

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The FY23 Omnibus funded the establishment of a National Emergency Tele-Critical Care Network (NETCCN) program at the Administration for Strategic Preparedness and Response (ASPR). This transitions NETCCN from a TATRC project that saved lives during COVID to an element of our national response plan.

March 2023

TATRC's Deputy Commander, COL Sharon Rosser was officially promoted to Colonel! The ceremony was held at the Military Women's Memorial, and hosted by the Director of the Defense Health Agency, and COL Rosser's mentor, Lieutenant General Telita Crosland. During the ceremony, she said, "Flexibility, commitment, and confidence are why I'm here today and why I'm blessed to be able to join the ranks of Colonel. I hope that I can do right and continue to grow from a place of humility, honesty, and selfless service to make each day better than the day before." We are all extremely proud of COL Rosser!

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TATRC Command Team gathered our Division leads and primary Section Chiefs for a strategic planning session to introduce and roll out the need to realign resources and reorganize in order to focus on automating casualty care! This two-day deep dive was instrumental in shaping how we will accomplish our aggressive goals as we move forward as a matrixed team.

FY23 Highlights
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From the Desk of TATRC's Senior Enlisted Advisor

For some time now, TATRC has focused on gaining Enlisted Soldiers as part of our staff in order to support and provide more realistic combat medic scenarios, and also for our data collection efforts, which is a key part of TATRC's new mission.

The relatively new addition of Enlisted Soldiers has enabled TATRC to do far more than simply demonstrate new tech or concepts to Distinguished Visitor's (although doing so is highly valuable to the organization), but has effectively become a litmus test for much of what we do. The ability for an engineer, app developer, or any other RDT&E professional to validate ongoing work with members of their targeted community, i.e. the Warfighter, is *invaluable*.

Having medics officially assigned to TATRC and sitting with the team on site provides the opportunity to seek early and frequent feedback in order to reduce wasted time, resources, and relational capital. I acknowledge the limitations of using Soldiers as research subjects, however their unique abilities can be leveraged in other ways to benefit the organization. I believe that only good can come from heavily involving Enlisted teammates in our work, and hope to see more frequent engagement as they settle in.

Now, with a core group of Enlisted Soldiers assigned to a rotation at TATRC, they are

SFC Jeremy D. Trapier, TATRC, Senior Enlisted Advisor

able to not only hone their skills as medics, but also be an important part of assisting in our data collection efforts. Their efforts have been vital to the success of our NEXUS lab and TATRC's mission.

FY23 Highlights

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April 2023

TATRC participated in MRDC's Capability Days. Not only were we highlighted as part of the 2035 Future's tent, but we also played a key role in the live combat casualty care scenario that ran throughout the three-day event. Our partners from John's Hopkins APL were on hand with us to showcase 'Spot,' the robotic dog who worked alongside a human Soldier to provide medical care to a simulated battlefield casualty, which was one of the highlights of the event. The team also demonstrated TRON, a telesurgical robotics initiative, remote ventilators, realistic moulage that simulated battlefield injuries, and much more! The event, designed to spotlight the key roles the command plays in both supporting and expanding the scope of military medicine, attracted more than 200 people from across the U.S. Department of Defense, the larger federal government spectrum and a variety of private sector entities for a sprawling, immersive series of scientific presentations and engaging product demonstrations.

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Dr. Jaeyeon Lee, TATRC's Orise fellow and Robotics Engineer demonstrated TRON during MRDC Capability Days back in April 2023.

SSG Jesse Hylton, one of the medics assigned to TATRC, competed in both the MRDC and AFC Best Squad Competition, and was part of the winning team for both events. SSG Jesse Hylton, a 68 C (LPN) led 5 other MRDC Soldiers as they competed in this exciting yearly event. This rigorous competition tested not only physical strength, but mental endurance as well. Events included activities like the Army Fitness Test, a written essay, M4 carbine and pistol qualifications, Day and Night Land Navigation Tests, an obstacle course and combat tournament, warrior task and battle drills, a ruck march, and an oral interview. Hylton moved onto the AFC Best Squad Competition, which was the next level up. He once again dominated the field at the AFC event in San Antonio and is now training for the next few months before traveling to compete in the Army's Best Squad Competition! Congratulations, SSG Hylton & team – we're looking forward to cheering you on in September!!

AMTI Alignment with DHAs Strategic Plan

Innovation provokes thoughts of great ideas and organizational shifts. The definition of 'innovation' as defined by Merriam-Webster is a "new idea, method, or device or the introduction of something new."

LTG Telita Crosland certainly introduced something new at this year's AMSUS, Association of Military Surgeons of the United States. She stated that: "We need to be leaders in exploring how to care for our people using technology that is available today, and that can be scaled tomorrow. We need to think more broadly and more boldly about what is possible. Not in a 10-year, over-the-horizon way. But today—what can we achieve in 2023. We've got to, as an organization, adopt a culture that embraces innovation in a disciplined way."

The Advanced Medical Technology Initiative (AMTI) has been fostering and supporting innovation since its inception in 1999 by the Army Surgeon General. The program focuses on support of intramural performance improvement and technology demonstration projects ($250K or less) that are submitted by change makers at military treatment facilities across the Defense Health Agency (DHA). These small investments can inform larger decisions as they are assessed on how well they can move the needle and demonstrate improvement in access, quality, safety, readiness, performance and/or cost. They also provide leadership with technology surveillance at the most practical level for exploration of the adoptability of new technologies and processes within military specific environments and cultures. They plant the seeds of change and spread them across staff and systems.

The AMTI program has had a tremendous impact on military health care and its leaders. Many senior leaders have been involved in the AMTI program and have participated in the development, review, execution, and/or administration of AMTI. Building a concept and plan around a great idea takes teamwork, resilience, and patience as it requires Innovators to touch aspects of the military health systems outside their normal scope of clinical practice and interact across systems. They must engage their colleagues to socialize a novel concept, research technical options, obtain Command and Information Systems support, engage resource management and/or contracting to garner the products and services required to complete their performance improvement or technology demonstration. They also promote their successful innovations at peer review conferences and publications and governance boards. Their passion projects have resulted in 9 programs of records, 250 plus peer reviewed publications, 300 plus peer review presentations, and 2 patents to date and these are just the ones that have been recorded.

Recently, the Defense Health Agency released, "The FY23-28 DHA Strategic Plan." The high-level graphic featured on the next page (see figure 1) provides an overview of the priorities, function, end state, initiatives and framework that make up this strategic plan.

Not surprisingly, the AMTI is in direct alignment with the DHA Strategic Plan to provide a platform to foster a culture of innovation and reward passionate and brilliant clinicians and professionals across DHA as it directly supports the plan by providing an exploratory opportunity to utilize the knowledge and expertise of clinicians and professionals at military treatment facilities (MTFs) and operational units (OUs), supporting the modernization of the force by identifying emerging technology capabilities that fill unidentified gaps within the military healthcare system. Specifically, AMTI, aligns with all the DHA strategic plan priorities in the following ways:

Priority 1: Enabling Combat Support to the Joint Force in Competition, Crisis, or Conflict.

Priority 1 implores everyone across DHA to "Listen better, address comprehensively and respond with urgency to challenges and bring flexible solutions (Pg.6, Priority 1). AMTI identifies problems and solutions sets from the front lines of care and has supported all services in both submissions and review of the program since 2020. The program provides actional aggregation, strategic alignment and systematic review of potential problems and solutions.

Priority 2: Building a Modernized, Integrated, and Resilient Healthcare Delivery System

Priority 2 encourages individuals throughout DHA to "Achieve new levels of excellence by fully leveraging emerging scientific and technological advancements (Pg.6, Priority 2)." AMTI funds evaluation of emerging technologies and empowers local teams to explore modernization efforts that are integrated in the current models of care to assess where technologies are likely to be impactful, adopted and prompt changes in modernization standard operating procedures (SOPs) and policy.

Priority 3: Dedicated and Inspired Teams of Professionals Driving Military Health's Next Evolution.

Priority 3 is also in alignment with AMTI as it provides a space to "create a fulfilling and revitalizing workplace where purpose drives performance (Pg.6, Priority 3). AMTI allows clinicians to work on passion projects that address real needs at the local level fueling retention and producing excellent leaders. The program empowers provider identification of scalable technological solutions and the intramural focus on military and GS civilians and acts as retention tool.

***AMTI** continued to page 9*

AMTI *continued from page 8*

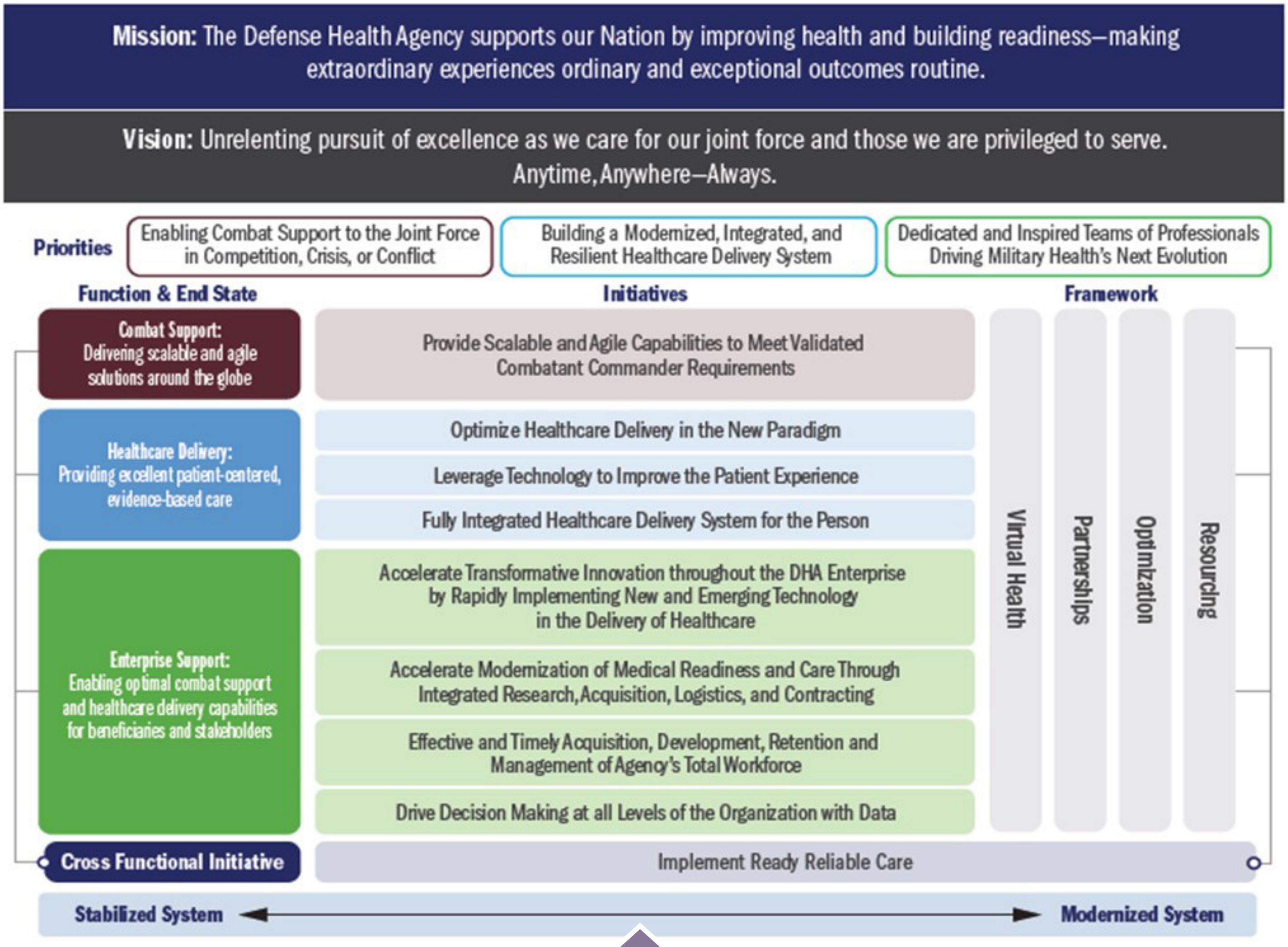

Figure 1: The FY23-28 DHA Strategic Plan

AMTI also aligns with "DHA's Strategic Plan and strategic function of enterprise support" by "accelerating transformative innovation throughout the DHA enterprise and rapidly implementing new and emerging technology in the delivery of health care" as it supports emerging technology evaluations in military treatment facilities and operational units and provides an easily accessible "ecosystem of rapid and disciplined prototyping" while rewarding the next generation of innovators from the ranks of DHAs incredible clinicians and professionals. AMTI also "accelerates modernization of medial readiness" as it combines small investments and evaluations through performance improvements and technology demonstrations and requires the involvement of contracting, research, logistics and acquisition to achieve success providing an opportunity to assess the right level of products and services. As previously mentioned, providing funding in support of intramurally developed great ideas and allowing an avenue for innovation ensures the retention of the DHA workforce. While AMTIs history includes a long list of achievements and the collection of knowledge and material products, these small assessments provide an opportunity to drive decision making at all levels of the organization by producing actionable and accountable data.

A culture of modernization requires cross matrixing across professions, teams, facilities, units, and systems and while it must be top driven it has to meet in the middle from the bottom up. Empowering the hard-working professionals throughout the system with an opportunity to enact and spread needed modernization and change across the military health system can be achieved through support for the next generation of AMTI's. The evolution of AMTI will incorporate the best of the decades old program while opening an opportunity to RAPIDLY assess technology solutions through teaming and accelerated proliferation of proven concepts and technologies.

1. *LTG Telita Crosland's presentation at AMSUS (top break out section)*
2. *FY23-28 DHA Strategic Plan (all other quotes)*

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