



UNITED STATES ARMY

INSTITUTE OF SURGICAL RESEARCH



2020

YEAR IN REVIEW

ARMY INSTITUTE OF SURGICAL RESEARCH
2020 YEAR IN REVIEW

U.S. Army Institute of Surgical Research

2020 Year in Review



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Front and back covers designed by:
Jennifer E. Donnelly, Marketing Specialist
US Army Medical Command



Army Futures Command Commanding General

Gen. John M. Murray

Army Futures Command Command Sgt. Major

CSM Michael A. Crosby

USA Medical Research and Development Command

Commanding General

Brig. Gen. Michael J. Talley

USA Medical Research and Development Command

Command Sgt. Major

CSM Victor Laragione

USAISR

Commander

Col. Mark E. Stackle, MD

USAISR

Senior Enlisted Leader

SGM Jennifer A. Francis

From the desk of the USAISR Commander

Looking back, 2020 was like no other year in the history of the US Army Institute of Surgical Research. When SGM Redding and I assumed leadership of the USAISR in July, San Antonio was in the throes of the COVID pandemic with some of the nation's highest infection rates. As a result, much of our critical combat casualty care research had come to a halt as we shifted our focus into transforming the vivarium into the Victory Intensive Care Unit and prepared to receive an influx of COVID patients. Fortunately, that surge of patients requiring hospitalization never materialized, and the research team resumed their work developing the next combat casualty care breakthroughs.

Meanwhile, the USAISR Burn Center team continued their tremendous work caring for patients suffering from burn injuries throughout the state of Texas. Furthermore, multiple Burn Flight Team members participated in several high-visibility patient transport missions from Europe back to the United States. The Burn Flight team also achieved a first in its history as multiple members completed the Air Force's Critical Care Air Transport Team (CCATT) advanced training course ensuring that the USAISR Burn Flight Team is fully qualified to integrate seamlessly with Air Force CCATT transport missions.

The USAISR team also contributed to the COVID relief efforts within the local community. Army medical laboratory specialists answered our Nation's call to serve when 12 of our outstanding Soldiers volunteered to assist the South Texas Blood & Tissue Center in San Antonio with collecting COVID convalescent plasma. During their 30-day mission, our Soldiers helped increase the collection of COVID-19 Convalescent Plasma by 150 percent in a two-week period. This collaboration was a huge success and earned praise from the highest levels within the Army and Department of Defense.

This year has been a remarkable one in the history of the USAISR and I could not be more proud of how members of our organization rose to the occasion to continue our research and clinical care missions while also supporting our nation's efforts to fight the COVID-19 pandemic. I am proud and grateful to be a part of this illustrious command. This 'Year in Review' issue serves to highlight our ongoing devotion to our combat wounded, and illustrate our commitment to our mission regardless of the circumstances. I hope you enjoy this issue as much as I enjoy sharing our successes.

Forge the Future!



Col. Mark E. Stackle, MD, USA
USAISR Commander



SGM Jennifer A. Francis, USA
USAISR Senior Enlisted Leader

Mission

Optimize Combat Casualty Care

Vision

The world's premier research organization enabling readiness and delivering evidence-based solutions for the optimal care of the combat wounded

OPERATIONALLY Responsive Clinical Research

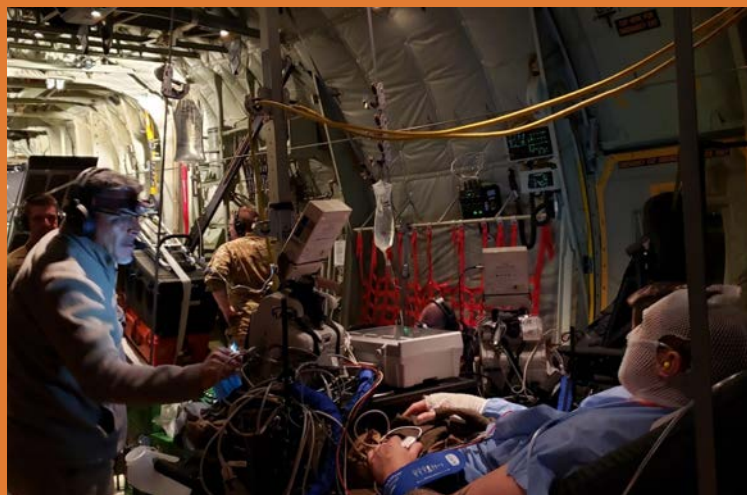


Essential Synergy between Clinical Care and Laboratory Research

USAISR Overview

The Army's premiere research organization focused exclusively on the combat wounded and home of the only Burn Center in the Department of Defense.

- One of six research institutes under the U.S. Army Medical Research and Development Command.
- Conducts requirements-driven, programmatic research to develop knowledge and materiel products that drive evidence-based, best clinical practice solutions and deliver advanced technologies for the Warfighter.
- The second burn center established in the U.S.
- One of only 70 American Burn Association verified burn centers in the world.
- Epicenter of burn research since 1949.
- Premiere translational research center focusing on trauma, burns, and critical care of the combat wounded—able to take clinical problems to the laboratory and translate laboratory advances to the clinic, operating room, or battlefield.



Accomplishments

Researchers Embark on Phase III Study Examining Safety and Efficacy of Cold Stored Platelets

In collaboration with Washington University in St. Louis, USAISR researchers initiated a multicenter, randomized study to evaluate platelet storage duration in cardiac surgery patients with active bleeding. The Chilled Platelet Study (CHIPS) allows for up to 21 day cold storage of platelets. In vitro work at the USAISR evaluated all platelet collection platforms, storage solutions, and pathogen reduction. CHIPS study outcomes are expected to extend platelet shelf life, increasing the inventory and availability when conventional platelet products are not available or their use is not practical. Ultimately these impacts will lead to improvement in care and increased survival of our service members on the battlefield.

Progress Toward Elimination of the Cold-Chain Requirement for Blood

Hemorrhage is the leading cause of preventable death on the battlefield. Blood availability limitations include shelf life constraints and cold-chain requirements. USAISR researchers identified alternative strategies to improve availability of critical blood products. The use of hemoglobin-based oxygen carriers (HBOC) as a reconstitution solution for freeze-dried plasma (FDP) was found to be superior to HBOC + water-reconstituted FDP in a pre-model of hemorrhagic resuscitation. These efforts represent the foundation towards development of an engineered plasma to treat hemorrhage and shock at or near the point of injury.

USAISR Hosts the Inaugural Joint Medical Effects of Directed Energy Injury: State of the Science Meeting

In collaboration with key leaders from Navy Medical Research Unit-San Antonio, USAF 711th Human Performance Wing, and USAF 59th Medical Wing, the USAISR hosted an inaugural Joint Medical Effects of Directed Energy (DE) Injury meeting. The intent of the meeting was to bring together lead scientists and key stakeholders to discuss the medical effects of DE and identify critical knowledge gaps in DE-related Warfighter sustainment and readiness. The event laid the groundwork to develop a joint DE research program focused on creating and delivering innovative medical capabilities needed to combat injuries from the application of DE technologies in future battlespace.

Researchers use Nobel Prize Breakthrough Drug as Anti-Shock Therapy to Improve Acute Survivability of Lethal Hemorrhagic Shock

Shock is the underlying pathophysiology that drives complications from hemorrhage leading to multiple organ dysfunction and ultimately death. USAISR researchers discovered that acute administration of Prolyl Hydroxylase Domain Inhibitors (PHDi) significantly improved survival in rats with lethal hemorrhagic shock. PHDi improves oxygen sensing (hypoxic adaptation) by regulating oxygen sensors during hemorrhagic shock. These studies suggest that PHDi is a promising anti-shock candidate that can be used independently or potentially bundled with other drugs and resuscitation strategies to treat hemorrhagic shock under Multi-Domain Operations and Prolonged Field Care scenarios.

Medical Laboratory Specialists Support Federal Response to the COVID-19 Pandemic

During the COVID-19 pandemic, medical laboratory specialists played a unique role in support of the Federal response to the pandemic. Patients recovering from COVID-19 generate antibodies to the SARS-CoV-2 virus, which circulate in their blood plasma. This plasma, called COVID Convalescent Plasma (CCP) can provide a life-saving therapy for other infected patients. On order from the Secretary of Defense, and at the request of the Secretary of Health and Human Services, USAISR deployed 12 Soldiers to the Texas Blood & Tissue Center (STBTC) in San Antonio for 30 days to assist in the collection and distribution of CCP from volunteers who recovered from COVID-19 infections. Because of the Soldiers' efforts, donor recruitment increased by 400 percent and collection by 150 percent during a two-week period. Further, in collaboration with Biomedical Advanced Research and Development Authority (BARDA), these efforts paved the way for the collection, distribution and storage of a national stockpile.

Burn Center

- Primary mission is Research and Development.
- The only military treatment facility co-located with a research laboratory which optimizes translational research.
- Serves as a regional burn center for South Texas and treats both military and civilian burn patients which helps maintain clinical currency and provides a readiness training platform opportunity.
- The Burn Intensive Care Unit has the highest acuity critical care patients in the DoD.
- Cared for major burns from all military conflicts since World War II, including 1,000 patients from Iraq and Afghanistan to date.
- Built on readiness which is supported by the following tenants: Research; Clinical Care; and Education.

589 total admissions in 2020:

- | | |
|-----------------|--------------------|
| - 476 civilians | - 36 beneficiaries |
| - 24 military | - 9 readmissions |



Army Burn Flight Team

- Home of the Army Burn Flight Team comprised of qualified, specially trained personnel.
- The Team has conducted nearly 100 overseas missions since 2003.
- Ready to deploy world-wide within 12 hours for both military and civilian patients in order for the patient to receive specialty burn care while in flight.



- **Conducted three missions in 2020:**
 - February: transported two active duty Soldiers from Colombia to the Burn Center.
 - July: transported one patient requiring inflight Extracorporeal Membrane Oxygenation (ECMO) from Kuwait to Mayo Clinic, Rochester, Minnesota.
 - September: transported one patient requiring inflight Continuous Renal Replacement Therapy from Bahrain to Mayo Clinic Rochester, Minnesota.

Burn Flight Team Members continued to attend the U.S Air Force Critical Care Air Transport Team Initial and Advanced courses. Nine members completed the Initial course and four completed the Advanced course. Future attendance and participation in CCATT training will ensure interoperability with the USAF CCATTs, and Burn Flight Team mission readiness.

Burn Center cont.

The Clinical Education Branch focused on expanding course offerings and increasing participation in the Clinical Pre-Deployment Training initiative.

Pre-Deployment Readiness Training is a two-week course available to teams of service members who are preparing for deployment. This training includes introduction to burn management with a focus on teambuilding, Advance Burn Life Support (ABLS) Certification (if available), hands-on training with skilled Burn Center staff and high-fidelity simulation training. A total of 804 hours of training were conducted on 86 team members for 13 deploying teams.



Clinical Burn Symposium, offered quarterly, is a two-day symposium which consists of lectures given by subject-matter experts from across the Burn Center. The Burn Symposium afforded attendees the opportunity to enhance knowledge about assessment, management and treatment modalities for burn patients. The lectures also introduced current clinical practice guidelines that impact care delivery. The Burn Symposium provided information that will immediately be applicable to all aspects of burn care for the novice or experienced healthcare provider. Four symposiums were conducted for 114 attendees issuing 53 continuing education hours.

Advanced Burn Life Support Provider Certification Program is an eight-hour course for physicians, nurses, physician assistants, nurse practitioners, therapists, and paramedics. This live, hands-on training provides the "how-to" of emergency care for a burn patient through the critical first 24 hours post injury. Ten classes were held for 138 attendees earning 75 continuing education hours.

Clinical Rotation Program allows non-physician students to apply knowledge from the classroom to real-life medical situations. During rotations, students shadow members of the multidisciplinary team in the Burn Center and have access to patients, in order to gain valuable hands-on experience. A total of 3476 clinical rotation hours at the Burn Intensive Care Unit and 1400 rotation hours in the Progressive Care Unit were provided.

In support of the Defense Medical Readiness Training Institute (DMRTI) and Brooke Army Medical Center (BAMC), the Clinical Education Branch provides the **Trauma Nursing Core Course (TNCC)**. TNCC delivers the knowledge, critical thinking skills and hands-on training needed to keep trauma patients safe. The overall course objective is to improve trauma patient outcomes by providing nurses with foundational trauma knowledge, skills, and a systematic Trauma Nursing Process to guide trauma patient care. A total of 328 hours were conducted on the TNCC.

The Clinical Education Branch augments the **Medic Utilization Program (Medic UP)** training for all Healthcare Specialists (68W) and Aerospace Medical Service Specialists (4N0) assigned to BAMC. This monthly training helps prepare 68Ws and 4N0s to manage burns in a prolonged field care environment. Twenty-five personnel attended Medic UP.

Continuing Education (CE), to include CME and CNE, helps those in the different healthcare fields maintain competence and learn about new and developing areas of their field. The activities take place as live events, written publications, online programs, audio, video, or other electronic media. 125.5 CME and CNE hours were earned at seven events.

The Burn Program supported the Burn Center mission of research, development, and Performance Improvement through various processes and functions in the areas of performance improvement and quality standards, resident rotations, data collection, and outreach.

During 2020, Burn Center published 39 peer-reviewed manuscripts and conducted 25 Performance Improvement projects.

Burn Center cont.



Burn Strong is the Burn Center's outreach program to the South Texas civilian community. It began as a partnership between the Burn Center and the San Antonio Fire Department (SAFD) in 2019, to help paramedics and emergency medical technicians learn the basics of advanced burn and trauma life support care.

Brent Sabatino and Rueben Salinas, Burn Center nurses held 9 classes before the COVID shutdown:

- January: (78 attendees at 3 SAFD classes) at the Centre for Emergency Health Sciences Sim Lab in Spring Branch, Texas.
- February: (103 attendees at 4 SAFD classes) at the Centre for Emergency Health Sciences Sim Lab in Spring Branch.
- March: (112 attendees at 2 SAFD classes and 2 classes in Laredo) at the Centre for Emergency Health Sciences Sim Lab in Spring Branch and Doctor's Hospital Laredo



Phoenix SOAR (Survivors Offering Assistance in Recovery) Program

The SOAR program connected burn patients and their family members to burn survivors, peer supporters, who shared their experiences about their injuries and going through the recovery and rehabilitation process in peer group meetings or one-on-one visits with patients in the Burn Center.

- Conducted three peer support groups: three in-person sessions (January-March) and then monthly virtual groups.
- Individual peer support: connected more than 20 recent burn survivors with other burn survivors who had developed post traumatic growth.
- Social event: hosted a game-day at Main Event entertainment center in January and served more than 150 meals to Burn Center staff during Christmas.
- Staff care: two burn survivors returned to share their stories at the burn symposium and a Burn Center in-service day.



Research Directorate

Comprehensive research programs address the DoD's most important requirements for medical advances to stabilize and treat combat casualties, to preserve life, limb, eye sight, and other critical functions for our wounded warriors – on the future battlefield and today.

- **676 Publications:**

- 111 Peer-reviewed Manuscripts/Journal Articles
- 115 Presentations - 276 abstracts - 174 Posters



20 Army Core Combat Casualty Care Research Program proposals funded

Studies spanned a wide spectrum of Combat Casualty Care related capability gaps to include:

- Pre-hospital anti-shock Drug/Hemostasis/Shock Treatment Capability and earlier detection of Acute Traumatic Coagulopathy.
- Early Post-Burn Treatment to Reduce Injury Progression and Bioburden and treatments for the far forward environment.
- Advances in Extracorporeal Life Support (ECLS) therapy such as eliminating need for anticoagulants, enabling earlier use of ECLS, before multi-organ failure.
- Multifocal approach for extending tourniquet times during Multi-Domain Operations.
- Development of ambulatory external fixation device for lower extremity combat injuries enabling a casualty with an open tib/fib fracture to self-ambulate.



Research Core Operations

- The vivarium has historically been designated as a back-up location in the event of a mass casualty scenario in San Antonio.
- As part of a potential COVID-19 patient overflow mitigation strategy, the vivarium staff, along with a specially appointed COVID-19 response team from the Burn Center, was tasked with converting the vivarium for human use to potentially receive human patients, to include the set-up of intensive care unit (ICU) beds.
- After 600 hours of work, 120,000 square feet of the vivarium were converted to treat 72 patients with 32 ICU beds.
- This new capability can be enacted within three days for immediate patient care (four beds) and three weeks for full conversion.

Clinical Research Support Department

Charged with facilitating clinical research in the Burn Center and is the nexus between the Burn and Research Directorate.

- Research supported by CRSD included prospective and retrospective studies initiated by the investigators in the Research Directorate Burn Center clinicians.
- Supported the local response to the COVID pandemic by facilitating enrollment in three COVID-related protocols, including two FDA-regulated and one epidemiologic protocols.
- Developed and executed 15 prospective protocols and 3 retrospective protocols initiated outside of the department, and 3 retrospective protocols and 1 prospective protocol initiated within the department.

Business Development/Office of Research and Technology Applications

Executed 55 new agreements including four Master Agreements with Texas A&M University Systems, UT Health Science Center San Antonio, the Geneva Foundation, and the Metis Foundation. These Master CRADAs are more flexible than single research project CRADAs, reduce bureaucracy, ultimately improving timelines to begin research activities.

Research Directorate cont.

- Facilitated delivery of four patent applications and one patent.
- Two inventions were granted Patent License Agreements.
- Provided support to Capability Area Managers in the development of intramural Army and extramural research proposals by reviewing budgets, transition plans, and impact statements.

Blood Research Program

- Platelets
- Whole Blood
- Anti-shock therapeutic
- Acute Traumatic Coagulopathy
- Cell Therapy (mesenchymal stem cells, MSCs) for immunomodulation in trauma
- Extra Corporeal Life Support (ECLS) coagulation and platelet function, sepsis coagulopathy
- Direct translation of research to operations

Tactical Combat Casualty Care (TCCC)



Conducted integrative and translational research focused on the prehospital environment (from point of injury to pre-surgical care), including air and ground evacuation, platelet function, and sepsis coagulopathy.

- The goal was to provide materiel and knowledge products to advance the level of care that can be provided given the tactical, environmental and patient factors inherent in the prehospital combat setting.
- Successful translation of research to the field will augment combat medic capabilities, thereby reducing mortality and morbidity in the battlefield space where the majority of preventable casualty deaths occur.

- Advanced knowledge of Tactical Combat Casualty Care care in pre-hospital hyperventilation and effects of analgesics on physiological functioning.
- Incorporated the hemorrhage control mission.

Prolonged Field Care Research Program

The mission is to move critical care capabilities far-forward for the prevention and treatment of secondary and treatment sequela resulting from delayed evacuation.

Lung Injury

- Developed small animal model of inhalation injury to serve as preclinical platform to test therapeutics for the mitigation of lung injury.

Acute Kidney Injury

- Determined that extremity trauma exacerbates acute kidney injury (AKI) following hemorrhage.
- Collaborated with Tactical Combat Casualty Care to develop treatments to prevent/reduce rhabdomyolysis induced AKI resulting from prolonged tourniquet application or muscle crush.

Acute Compartment Syndrome

- Evaluated current and emerging technologies for the detection/diagnosis of acute extremity compartment syndrome.
- Retrospective analysis of 515 lower extremity vascular injuries among casualties from OEF/OIF documented complications and morbidities associated with early fasciotomy.

Sepsis Detection/Treatment

- Developed a new prolonged care relevant swine sepsis model for testing early detection devices and therapeutic treatments.

Research Directorate cont.

Trauma Immunology

- Developed a new clinically relevant swine blast injury and hemorrhage model to serve as preclinical platform to test therapeutics for mitigation of organ injury.

Assessment of Inter-Organ Cross Talk

- Established inter-organ cross talk in acute respiratory distress syndrome (ARDS) and AKI in burn patients.
- Unique data on local and systemic expression of HMGB1 ((High Mobility Group Box 1, a protein coding gene) has been acquired in different models of trauma induced ARDS.

Burn and Soft Tissue Research

Provided new treatment options to address the current gaps in burn care on the battlefield and at the Burn Center.

- Developed a novel antimicrobial dressings to improve wound healing.
- Developed treatments to decrease the secondary systemic complications and burn wound progression.
- Improved and validated temporizing skin cover solutions that promote healing and the need for evacuation.

Dental and Craniomaxillofacial Trauma

- Focused on developing solutions for traumatic injuries to the head and face for Soldiers with burn injuries who cannot receive the civilian standard of care of early eschar excision and grafting.
- Research was ongoing to formulate a cerium-ion-releasing solid dressing as well as a silver-cerium combination solid dressing.

Battle Field Pain Management and Sensory Trauma

Sensory Trauma was recently reorganized to broaden research depth and scope to deliver medical solutions for ocular and auditory trauma, Medical Effects of Directed Energy, and Battlefield Pain Management.

- Coordinated the Inaugural Joint Medical Effects of Directed Energy: State of the Science meeting.
- Developed an Amniotic Membrane Ring Device for use as initial eye injury treatment.
- Expanded USAISR combat casualty research capabilities which included trauma-related Auditory dysfunction.
- Served as the primary coordinator for the Oak Ridge Institute for Science and Education (ORISE) Virtual Summer Undergrad Research Program.
- Continued work on "Penetrating Ocular Injury Model."
- Pain and injury biomarkers identified in pre-clinical model.
- BARDA funding supported efforts to characterize the pathophysiology of combined radiation and traumatic injury.
- Established a cross-departmental analgesic drug evaluation pipeline.

Orthopaedic Trauma Research Department

Placed particular importance on issues that will be encountered during Prolonged Field Care (PFC).

- Research was focused on returning wounded warriors to the fight and preventing wound progression when evacuation is delayed.
- Focus shifted from knowledge projects, which are incremental improvements, to materiel solutions.

Engineering Processes and Product Development Group

Researched and developed solutions and concepts that utilize information and engineering technologies to improve outcomes of combat casualties from point of injury to Role of Care 3.

Experts in state of the art software and engineering development capabilities that included expertise in medical Artificial Intelligence, Machine Learning, and automation technologies which are key to addressing current and future capability gaps for the Army.

Research Directorate cont.

Knowledge and Materiel Products

A total of 33 Knowledge and Material Products for 2020. Here is a sample of those products.

Knowledge Products

- **Airway Device:** Findings demonstrated that three of the most popular, low-fidelity manikins used to train clinical providers on placing an airway device are not anatomically correct when compared to CT scans of human airway anatomy.
- **Pain Management:** Determined that analgesic doses of opioids currently available on the battlefield (morphine, fentanyl, sufentanil) do not produce cardiorespiratory depression following traumatic hemorrhage in research model.



- **Lung Ventilation:** Demonstrated that acute bag-valve hyperventilation such as that occurring during prehospital phase of care does not produce evidence of inflammation or lung injury in research models.



- **Burn Care:** Created a web page that enables users to gain important information quickly and easily compared to paper burn critical practice guidelines.

Materiel Products

- In development: a removable topical anti-scar patch containing Pirfenidone, an FDA approved anti-inflammatory and anti-fibrotic drug.
- Continued development of a novel cerium+silver dressing for burns.



- In progress: Successfully carried out first step in preliminary testing of two new, biologically-friendly polymer/tubing coatings in support of anti-coagulant free Extracorporeal Life Support (ECLS) coatings.
- In Development: An anterior segment organ culture platform for assessment of open globe injuries up to 72 hours post-injury.
- Determined Kerecis Fish Skin Graft is an acceptable temporary covering for treatment of surgically debrided deep partial and full thickness burn wounds when evaluated in research models.



- Under Development: Initial algorithm development for autonomous tourniquet implementation.



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