

# Combat Casualty Care Research at the U.S. Army Institute of Surgical Research

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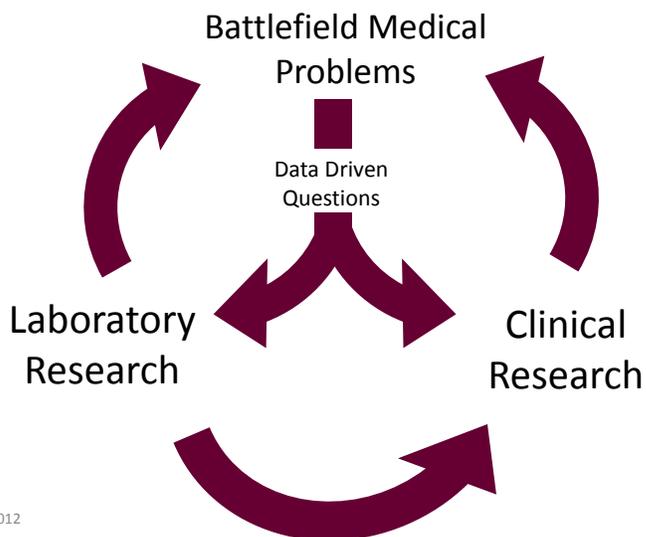
## Mission of the US Army Institute of Surgical Research



### Optimizing Combat Casualty Care

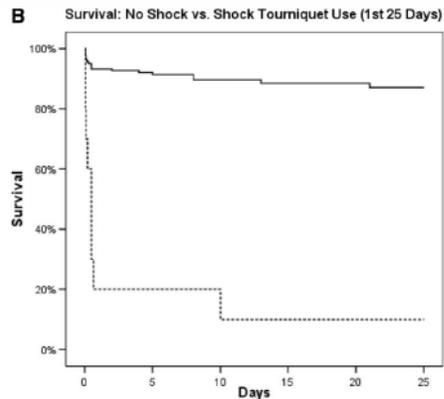
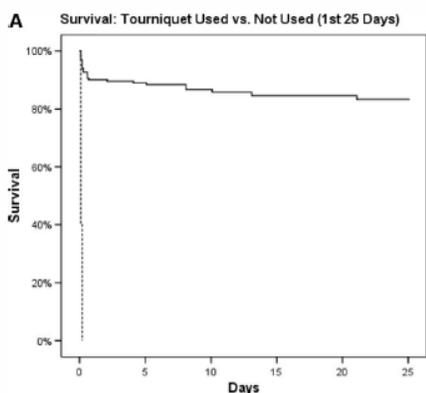
- Provide requirements driven combat casualty care medical solutions and products for injured soldiers from self-aid through definitive care across the full spectrum of military operations
- Provide state-of-the-art burn, trauma, and critical care to Department of Defense beneficiaries around the world

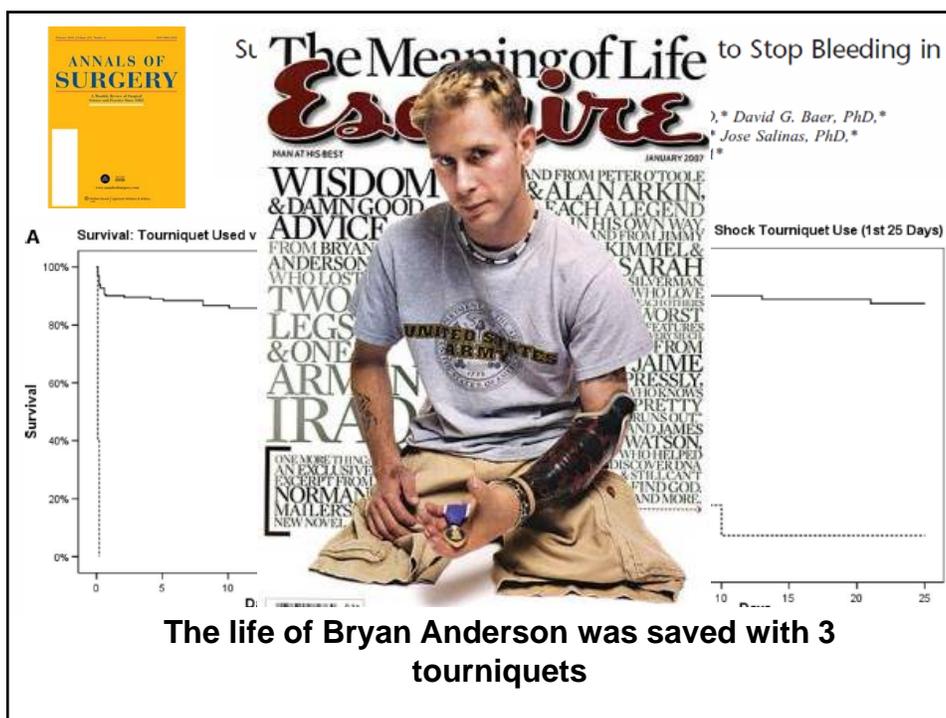
## The Research Philosophy of The U.S. Army Institute of Surgical Research



### Survival With Emergency Tourniquet Use to Stop Bleeding in Major Limb Trauma

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## ISR Contributions to Improved Combat Casualty Care For Soldiers

2004 Army Greatest Invention – Hemcon Dressing  
 2005 Army Greatest Invention – Combat Tourniquet  
 2007 Army Greatest Invention – Damage Control Resuscitation  
 2008 Army Greatest Invention – Combat Gauze Dressing  
 2009 Army Greatest Invention – Burn Resuscitation Decision Support

- **Hemostasis Innovations**
- rFVIIa to treat coagulopathic bleeding
- Fluid warmers to prevent hypothermia
- Hypothermia prevention kit
- Intraosseus Infusion Systems
- Hextend
- Antibiotics by medics
- Pain control by medics
- Improved burn wound diagnostic tool
- Joint Theater Trauma System
- Battlefield burn prevention
  - Safe burning of waste
  - Use of Nomex gloves
  - Burn prevention shirt
- Needle Thoracentesis to treat pneumothorax pre-hospital
- Ultrasound to diagnose pneumothorax
- Individual First Aid kit
- Vehicle First Aid kit
- Fresh Whole Blood
- Tourniquet use guidelines and doctrine
- Hypotensive resuscitation guidelines
- Renal replacement therapy for burn
- Blood product resuscitation
- Impedance threshold device for hypovolemia

As of: 26 Sep 05

## Damage Control Resuscitation

- Recent Accomplishments
  - Tourniquets
  - 2<sup>nd</sup> and 3<sup>rd</sup> Generation Hemostatic Dressings
- Current Focus Areas – Reducing KIA and DOW Rates
  - Hemostatic Resuscitation – Restore volume, avoid coagulopathy, provide oxygen carrying capacity
  - Avoid giving blood products to those who do not need them
  - Prevent hypothermia



## Blood Research Program

- Recent Accomplishments
  - Transition of Freeze-Dried Plasma and Cryo-Preserved Platelets to Advanced Development (clinical trials)
- Current Focus Areas
  - Understanding basic mechanisms of trauma-induced coagulopathy
  - Developing improved platelet storage systems
  - Developing blood product pathogen reduction technologies



## Extremity Trauma & Regenerative Medicine

- Recent Accomplishments
  - Defining the injury patterns and resulting functional outcomes
    - Open fractures
    - Soft tissue defects (muscle and nerve)
    - Wound irrigation and debridement
- Current Focus Areas
  - Animal modeling of traumatic injury
    - Segmental defects (bone and muscle)
    - Wound contamination and infection
  - Muscle Regeneration
  - Delivery of autologous stem cells to treat defects
  - Establishment of the Major Extremity Trauma Research Consortium
    - Partnership between military treatment centers and civilian trauma centers
    - Clinical trials comparing
      - Autograft vs. allograft with recombinant Bone Morphogenetic Protein -2
      - External fixation (circular fixation) vs. early internal fixation
      - Systemic antibiotic therapy vs. antibiotic therapy with local antimicrobial delivery



## Pain Control

- Recent Accomplishments
  - Defining the relationship between pain control and Post Traumatic Stress Disorder
  - Influence of anesthetic agents on Post Traumatic Stress Disorder
- Current Focus Areas
  - Use of virtual reality immersive environments for pain control
  - Intranasal ketamine for battlefield pain control
  - Intravascular thermal regulation during surgery



## Advanced Capabilities for Emergency Medical Monitoring

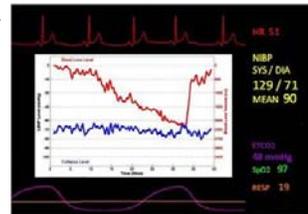
- **Recent Accomplishments**

- Impedance threshold device to support cardiac output during central hypovolemia



- **Current Focus Areas**

- Investigation of mechanisms of tolerance to hypovolemia
- Development of wearable physiologic status monitor
- Remote triage devices and algorithms



## Combat Casualty Care Engineering

- **Recent Accomplishments**

- Development of decision support technology for burn resuscitation
- Analysis techniques for vital signs to improve situational awareness

- **Current Focus Areas**

- Integration of existing vital signs to improve decision support
- Analysis of vital signs collected in the deployed pre-hospital and emergency department environment
- Ventilator support after lung injury (smoke inhalation and blunt trauma)
- Development of improved metrics for adequacy of resuscitation



## Clinical Trials

- **Recent Accomplishments**
  - Continuous renal replacement therapy
  - Burn injury prevention through fire retardant garments
- **Current Focus Areas**
  - Multicenter clinical trials
    - Engineered skin grafts
    - Transfusion triggers in burn surgery
    - Assessment of rehabilitation requirements
    - Donor site dressings
    - Prospective evaluation of transfusion ratios
    - Decision support, decision assist

## Medical Countermeasures for Ocular Trauma Science Program

- Assessment of military ocular trauma
  - Laser-induced eye injury from military systems
  - Ocular Injury from blast (new – FY2011)
  - Biophysical models
  - Ocular trauma research roadmap
- Triage and Treatment of Ocular Trauma
  - Retinal Injury: Mechanisms and Taxonomy
  - Pharmacological Intervention- Stem Cell Therapies
  - Advanced imaging diagnostics (OCT, SLO)
  - Vision and performance metrics
  - Advanced Aidman Vision Screener
  - Informatics – Laser exposure incidents
- Laser Bioeffects – Force Protection
  - Exposure Guidelines - Field Safety (AR 11-9)
  - Injury prevention – Health Hazard Assessment
  - Military eye protection systems (MEPS)



## Summary

- ISR provides requirements driven combat casualty care medical solutions and products
- ISR's mission space is trauma, head to toe, minus the brain
- Extensive collaborations with clinicians ensures rapid response to emergent problems
- The partnership between the ISR and the DHB Tactical Combat Casualty Care subcommittee has been extraordinarily successful