

MILITARY MEDICINE:

CARING FOR THE WOUNDED WARRIOR AND
HOW IT IMPACTS ON CIVILIAN TRAUMA
CARE

LANDSTUHL
REGIONAL
MEDICAL
CENTER

EMERGENCY ROOM



6th Annual McSwain EMS Trauma Symposium

RONALD I. GROSS, MD, FACS
St. Francis Hospital & Medical Center
Hartford, CT
COL (Ret) MC USAR

DISCLOSURES

A silhouette of a helicopter is shown in flight against a bright sky. The sun is visible on the left side, creating a large, bright flare. The helicopter is positioned in the upper middle part of the frame, with its main rotor blades and tail rotor visible. The background is a clear blue sky with some light clouds near the horizon.

I have no financial disclosures

I have no conflicts of interest

The bottom of the slide features silhouettes of trees and a building against a dark background. The trees are of various heights and shapes, and the building is partially visible on the left side. The overall scene is dark, suggesting a sunset or sunrise.

Is Military Medicine Really Different?

Civilian

- Higher level of care
- Patient stability mandatory
- Transfer agreements
- Logistics of transportation
 - Weather/location dependent
 - Ground
 - Air
 - Training

Military

- Higher level of care
- Patient stability a bonus
- AO/Theater evacuation policy
- Logistics of transportation
 - Mission/tactically dependent
 - Weather/location dependent
 - Ground
 - Air
 - Training
 - SECURITY

Military Surgery

- Military or war surgery is a subset of surgery (trauma surgery PLUS...)
- Emergency surgery done on mass production basis, in austere & resource-limited environment
- Do what must be done--not what can be done
- Care-givers are in danger themselves
 - 10% wounded while giving aid

- Civilian trauma centers and battlefield/military triage situations differ
- Civilian trauma centers
 - small numbers of patients, unlimited resources
- Military setting
 - limited numbers for potentially unlimited patient numbers

MILITARY TRAUMA IS DIFFERENT THAN CIVILIAN TRAUMA



THE CHALLENGE



- AMEDD Motto:
 “To Conserve Fighting Strength”
- Provide advanced medical/surgical care as far forward as possible
- Preserve life, limb, eyesight
- Return the wounded to his/her unit
- Return the wounded to his/her family

Medical/Surgical Needs for a Combat Surgeon

- Pre-hospital stabilization & care
- Emergency surgery:
 - “Trunkey Trauma Training”
 - Thoracic
 - Abdominal
 - Vascular
 - Urologic
 - Orthopedic
 - Neurosurgical
 - Critical care

Medical/Surgical Needs for an Acute Care Surgeon

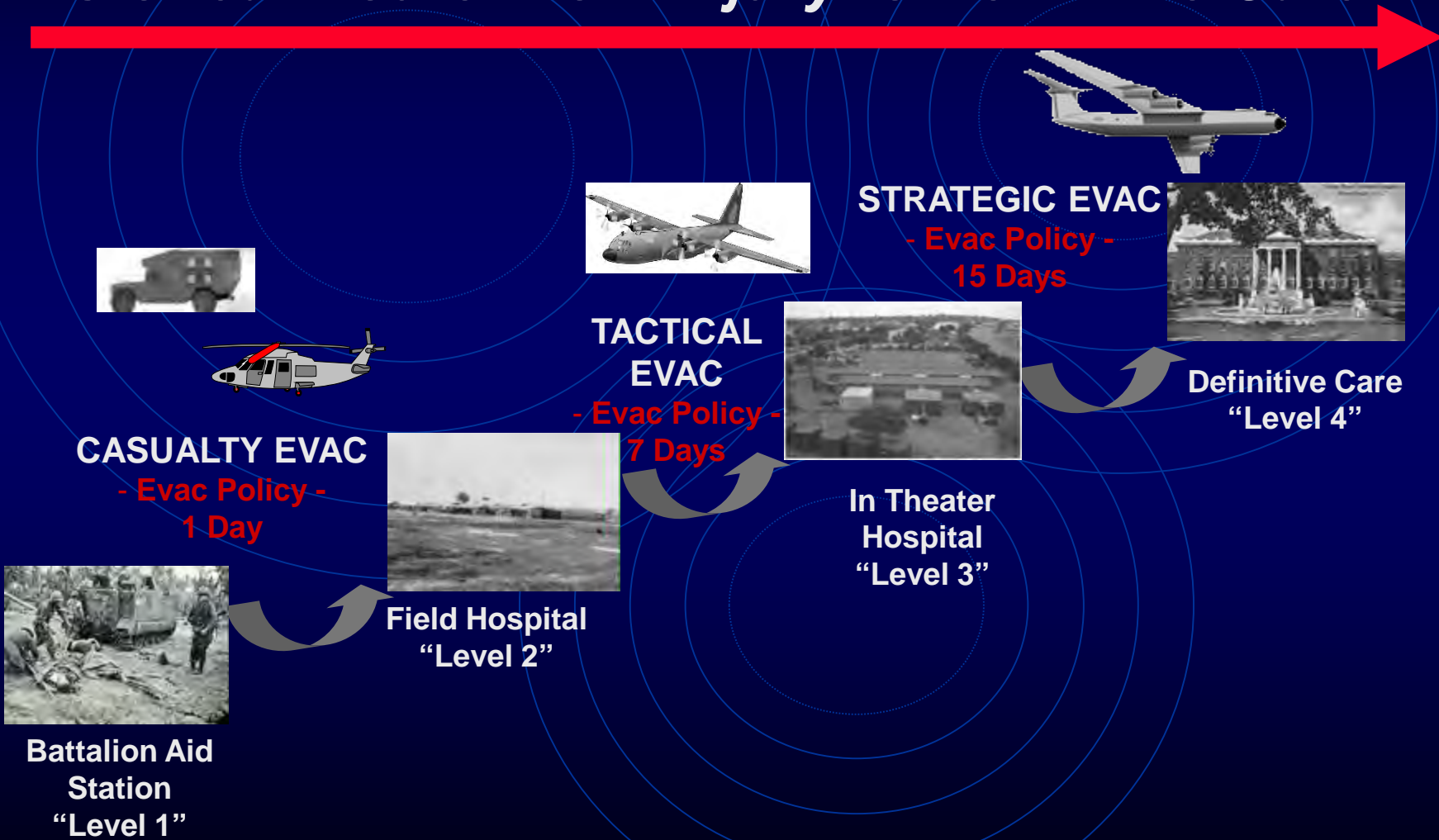
- Pre-hospital stabilization & care
- Emergency surgery:
 - “Trunkey Trauma Training”
 - Thoracic
 - Abdominal
 - Vascular
 - Urologic
 - Orthopedic
 - Neurosurgical
 - Critical care

"Traditional" Battlefield Medicine

- Linear movement of troops – “slogging it out”
- Combat support
 - Long range fire
 - Heavy air support
 - Close air support
 - Tactical situation dictates medical capabilities
- Emphasis on Bde, Bn, Corps, Divisional assets

Continuous En Route Care

Historical Route From Injury to Definitive Care



Recent Conflicts Present Changing Paradigm

- Non-linear nature of conflict presents major issues with security
 - No clear “front line”
 - Green zones interspersed between “hot zones”
 - Force protection a major concern during transport
 - Geneva Convention prohibits vehicles marked with “Red Cross” from carrying offensive weapons
 - Geneva Convention prohibits firing on vehicles marked with “Red Cross”.....YEAH RIGHT!
 - Medical units cannot execute MEDEVAC convoys

Recent Conflicts Present Changing Paradigm

- Unprecedented “non-linear” rapid movement of FLOT
- Battlefield changes daily
- AMEDD mission changes daily
 - Tactical issues
 - Medical needs
 - Logistical support
 - Evacuation capabilities
- Specter of “non-conventional” warfare



OIF/OEF Dilemma:



Non-linear/Asymmetrical Warfare

The Challenge-

Create lightweight, lean and mobile
capability

Austere but adequate within a
meaningful distance to the injured

The FST- Forward Surgical Team



Mission of Forward Surgical Team

- Far-forward surgical presence in areas of most intense conflict
- Life-saving operations for highly lethal wounds
 - laparotomy
 - thoracotomy
 - craniotomy
 - vascular repairs
 - amputation
 - external fixation
- “Damage Control” Surgery

What is “Damage control” surgery?

- Situation: rapid exsanguination, shock
- Avoid lethal triad: hypothermia, acidosis, coagulopathy
- Goals: stop bleeding, seal GI leak, pack, close skin, finish within 30 minutes
- Survival increases from 5% to 25%
- Requirements: more than a fast surgeon







Mortar Motel







FWD

ATLS

S









New Problem

- Stabilized, but not stable, patient now sitting in the middle of the desert
- Hard to provide resource intensity and duration of care in austere environment

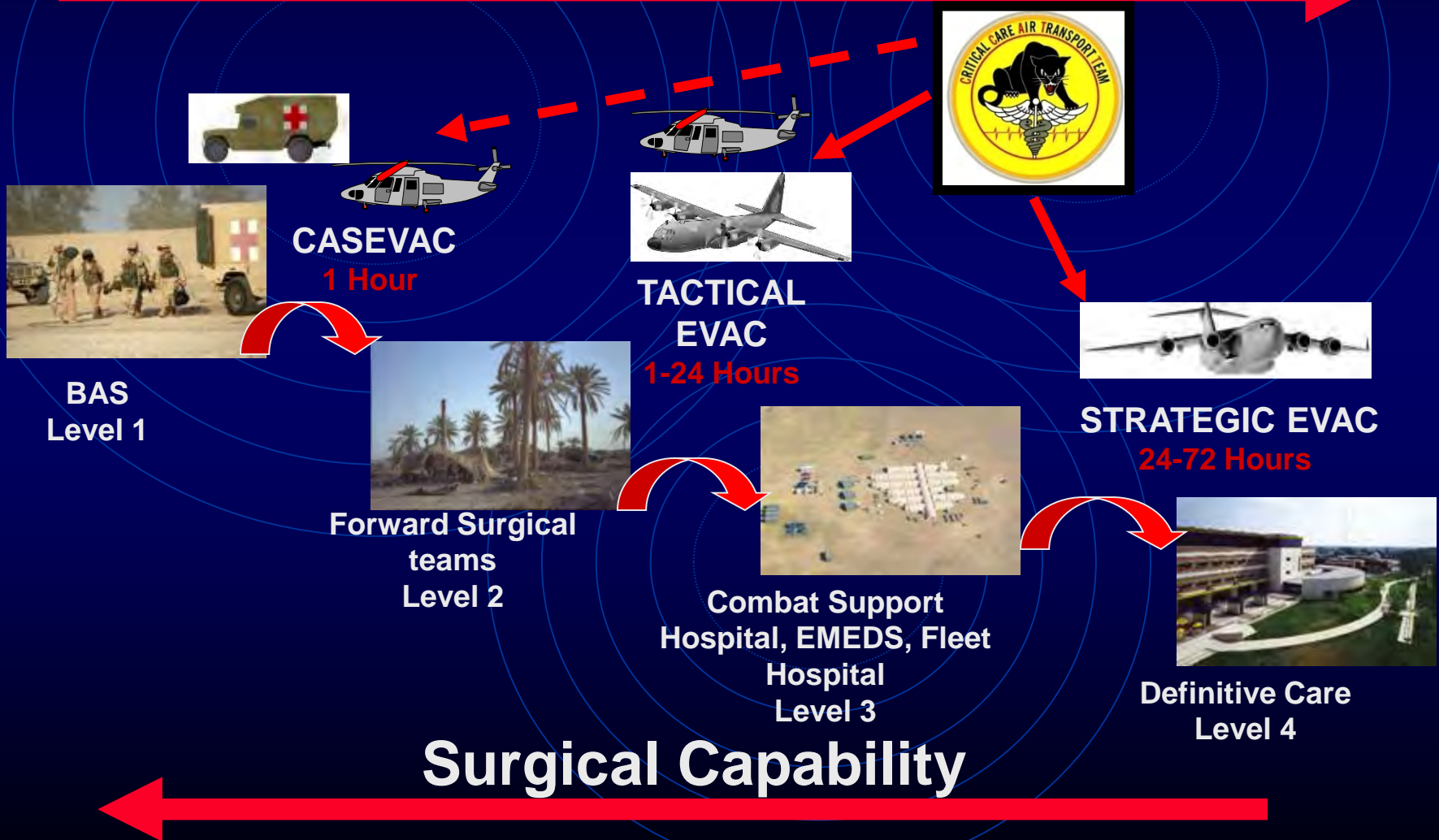


Solution - CCATT



Continuous En Route Care

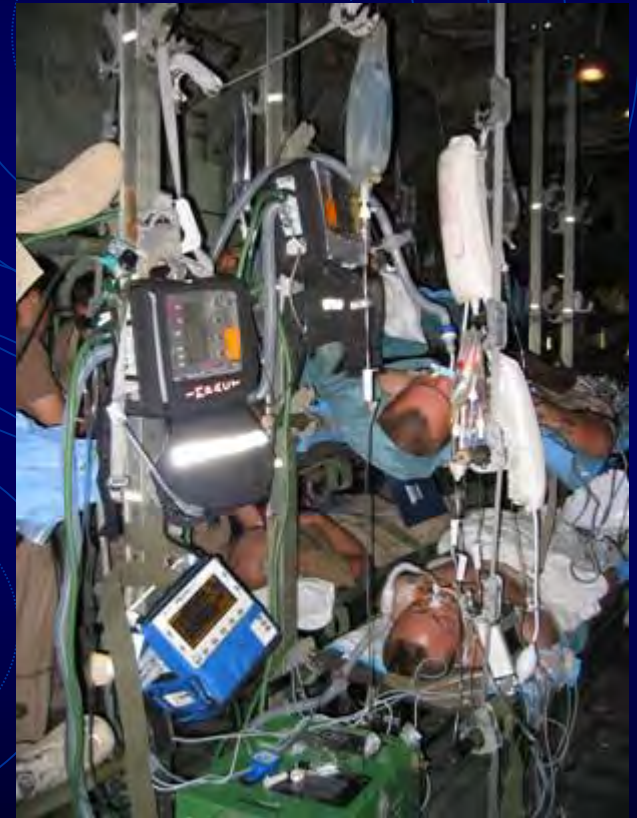
Current Route from Injury to Definitive Care



CCATT Mission Reports

In flight care (OEF/OIF)

- Mechanical Ventilation 58 - 85%
- Vasoactive or sedative drips 54%
- Neuromuscular blockade 4%
- Arterial pressure monitor 27%
- Intracranial monitor 4 - 25%



Time 0

- MP HMMV on patrol is struck and disabled
- Sgt J.B. lifts the hood to investigate
- He is struck in the mid back by sniper round

Time 45 minutes

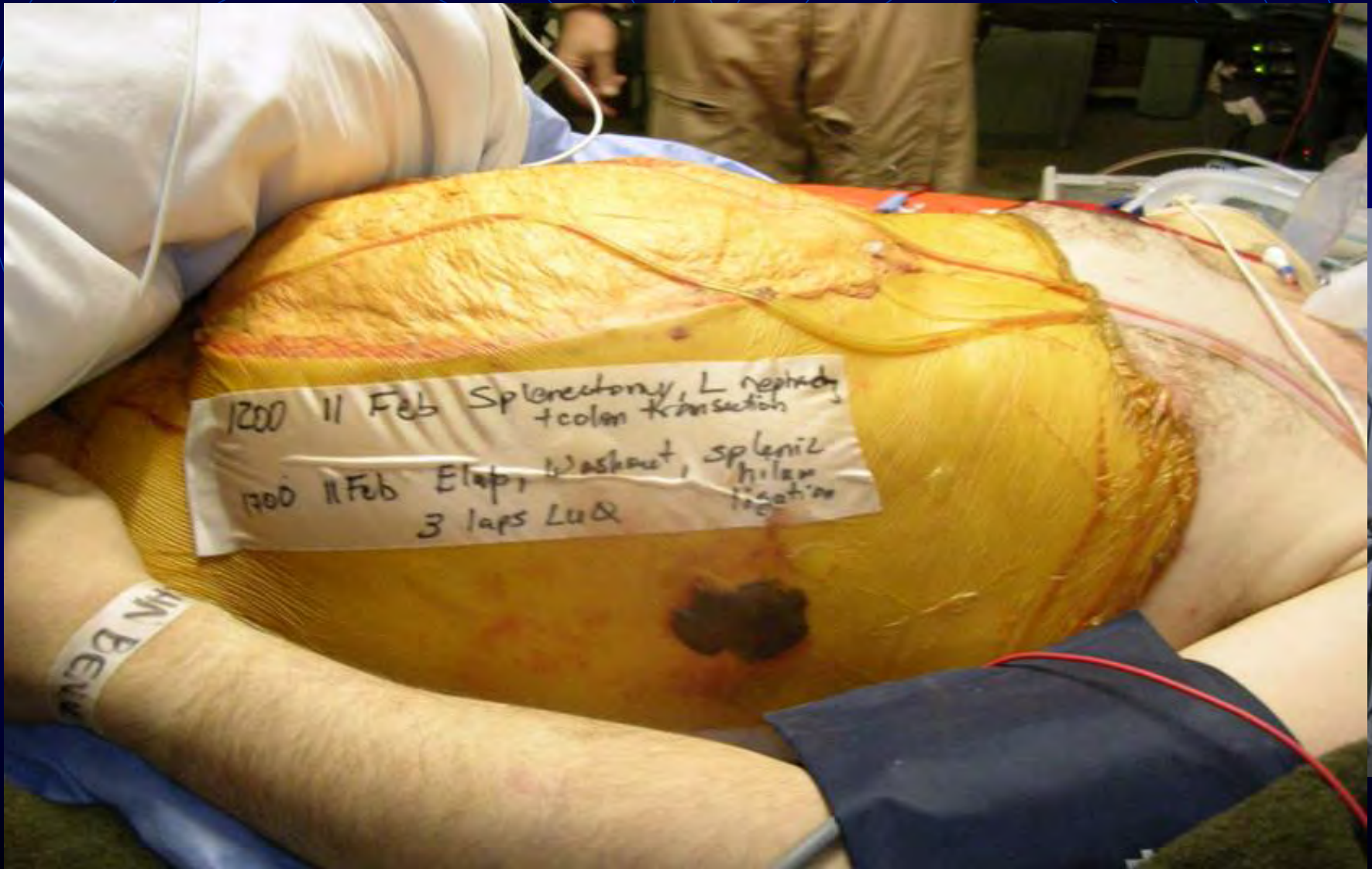
- Taken to Level II Army FST in Kirkuk
- Arrival B/P 80 systolic
- Undergoes exploratory laparotomy-
 - Left Nephrectomy
 - Splenectomy
 - Packing of abdomen
 - 8 units PRBC's
 - B/P 90's systolic



Time 3 hours



Time 3-6 hours



Time 6 hours

- Transported to ICU
- CT scan of spine
- Completion of resuscitation
- “Urgent” evacuation request placed



Time 10 hours

- C-17 arrives from Germany
- Cargo unloaded
- Aircraft reconfigured
- CCATT team alerted
- Patient prepared for transport



Time 10 hours

- CCATT arrives at ICU
- CCATT moves patient to AMBUS to flight line
- Patient loaded for flight



Time 12 Hours

- Patient loaded for flight and takeoff
- 6 hour mission to Germany
- AMBUS transfer to LRMC



Time 18 Hours



Time 24 hours

- Taken to OR PI day 2 packing is removed
- Colon continuity restored
- Washed out PI day 5
- Definitive decompression and stabilization of L-2 completed PI day 9



LANDSTUHL REGIONAL MEDICAL CENTER
SELFLSS SERVICE

LANDSTUHL
REGIONAL MEDICAL CENTER
ONE TEAM ONE CARE FORCE



06:49 07:49 11:49 13:49 15:49 16:19
SAN ANTONIO WASHINGTON ZULU GERMANY IRAQ AFGHANISTAN

PROCESS
ED
SES ONLY
WHEN LEFT UNATTENDED



United States Army Medical Information Technology Center

Enterprise IM/IT Management Product Development and Management IM/IT Operations, Support, and Integration

Video Network Center

Fort Sam Houston, Texas

1-800-USAMITC (872-6482) "Option 2"
DSN: (312) 421 Fax: (210) 295-3508
<https://vtc.medcom.amedd.army.mil>
Customer Survey:
<https://vtc.medcom.amedd.army.mil/survey>

POLYCOM MGC

0:15





EMERGENCY EXIT

CAPACITY
STANDEES

RICE ETTS

ROPAL

SPEED

PERISHABLE
AVOID
HEATING OR FREEZING

Post-Injury Day 14

- Patient transferred s/p lumbar decompression by CCATT team to WRMC.



Current Equipment Suite

- Good news
 - It works well enough
 - All services have settled on the same equipment
- Bad News
 - It's old
 - It's heavy
 - It's clumsy
 - The pieces are not meant to work together



CCATT Equipment



Equipment Bags
Total Weight: 500+ lbs

**Propaq
Monitor**



**IVAC IV
Pump**



**Impact
Ventilator**
AC, SIMV, CPAP
PEEP



**I-STAT Lab
device**



Tactical CCATT

- Light *Minimal*
- Noise *Lots*
- Vibration
- Altitude *High*
- Duration *Long*



Autonomous Control Units



Autonomous oxygen control

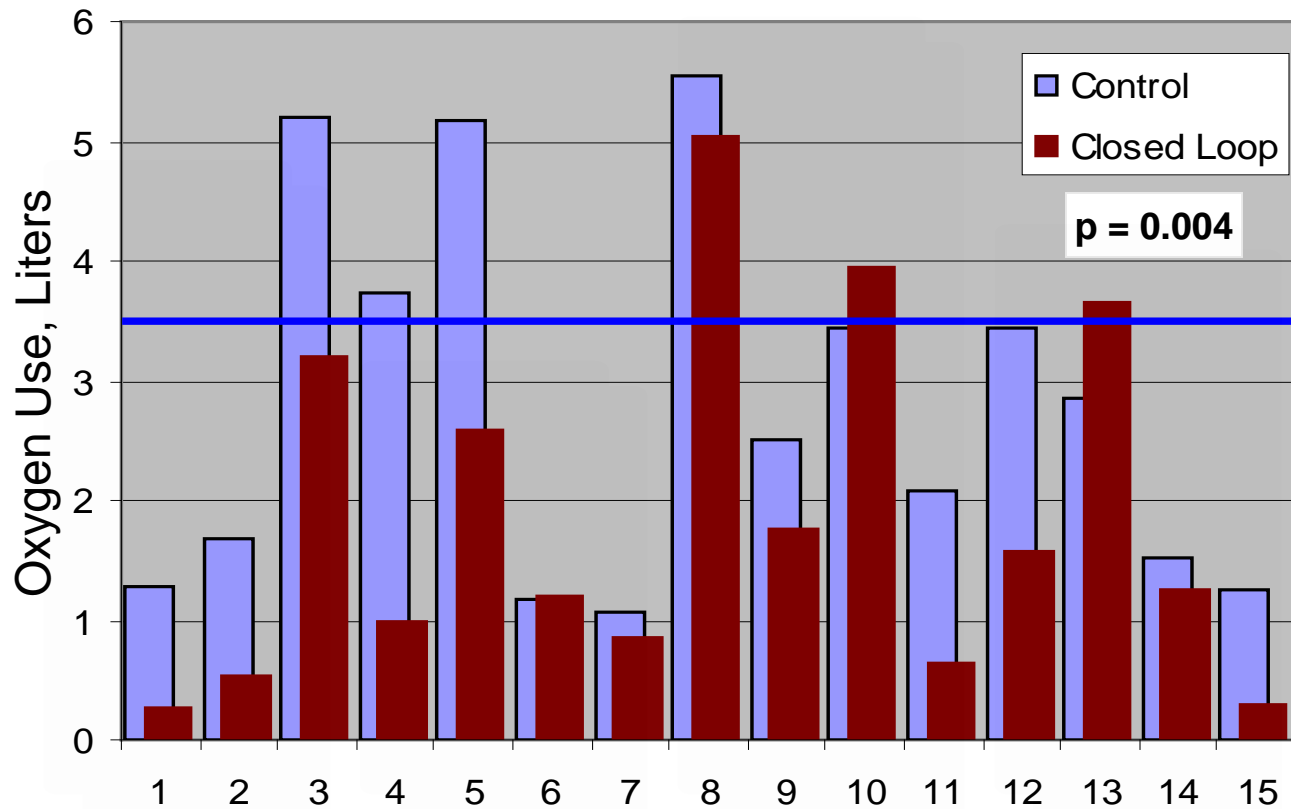
- In the deployed setting Oxygen is a critical resource
- Assumption-
It is desirable to decrease FiO_2 as long as SaO_2 is maintained
- Input controller- SaO_2
- Output controller- FiO_2



Closed Loop Clinical Trial

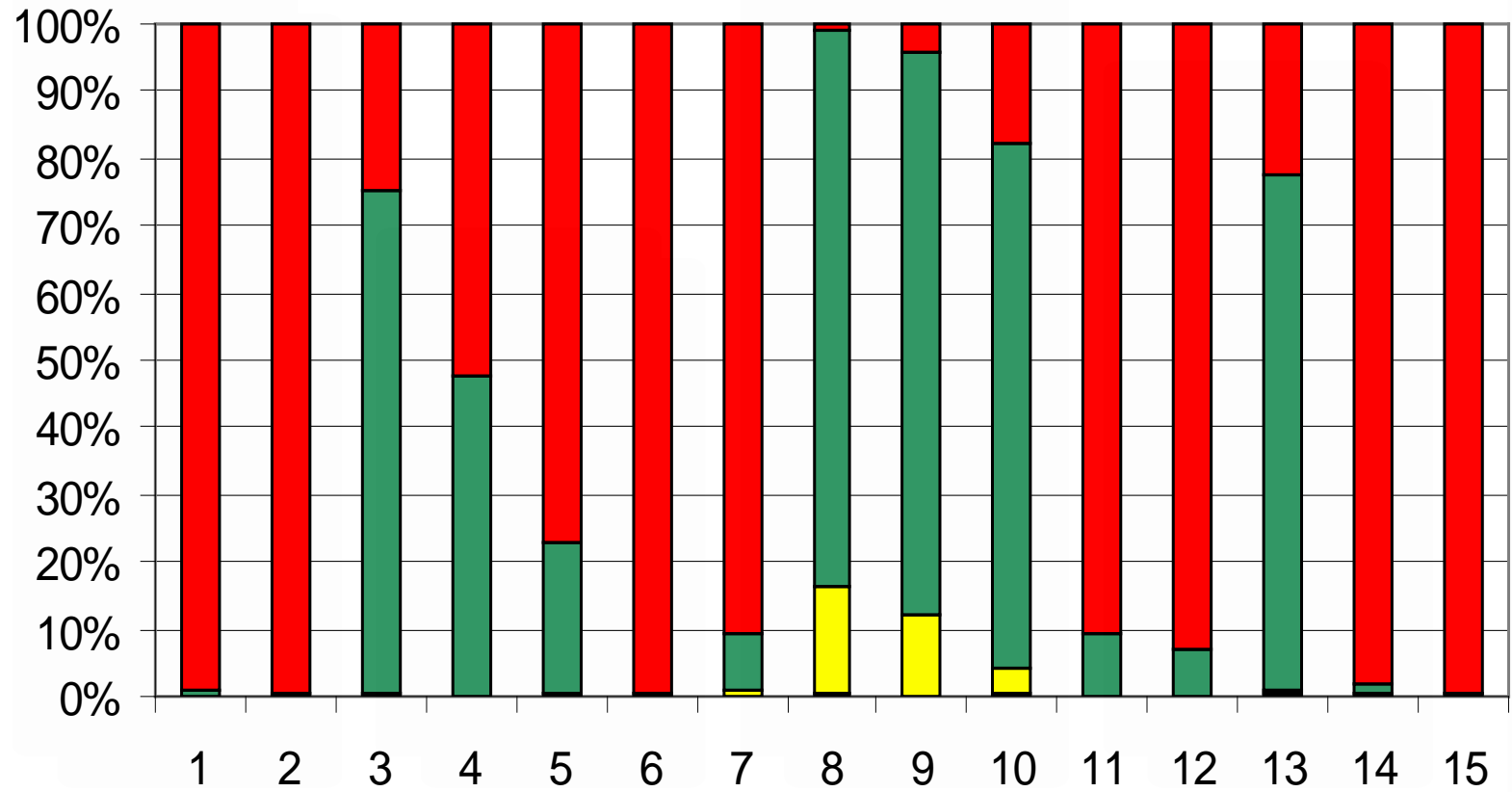
- Clinical trial of up to 50 patients
- Four hours of manual and four hours of automatic FIO₂ control in randomized fashion
- Both sexes, 18-55 years of age
- Multiple trauma patients
- Current FIO₂ > 35%
- Target - SaO₂ 92 – 96%

Results- closed loop control of FiO2

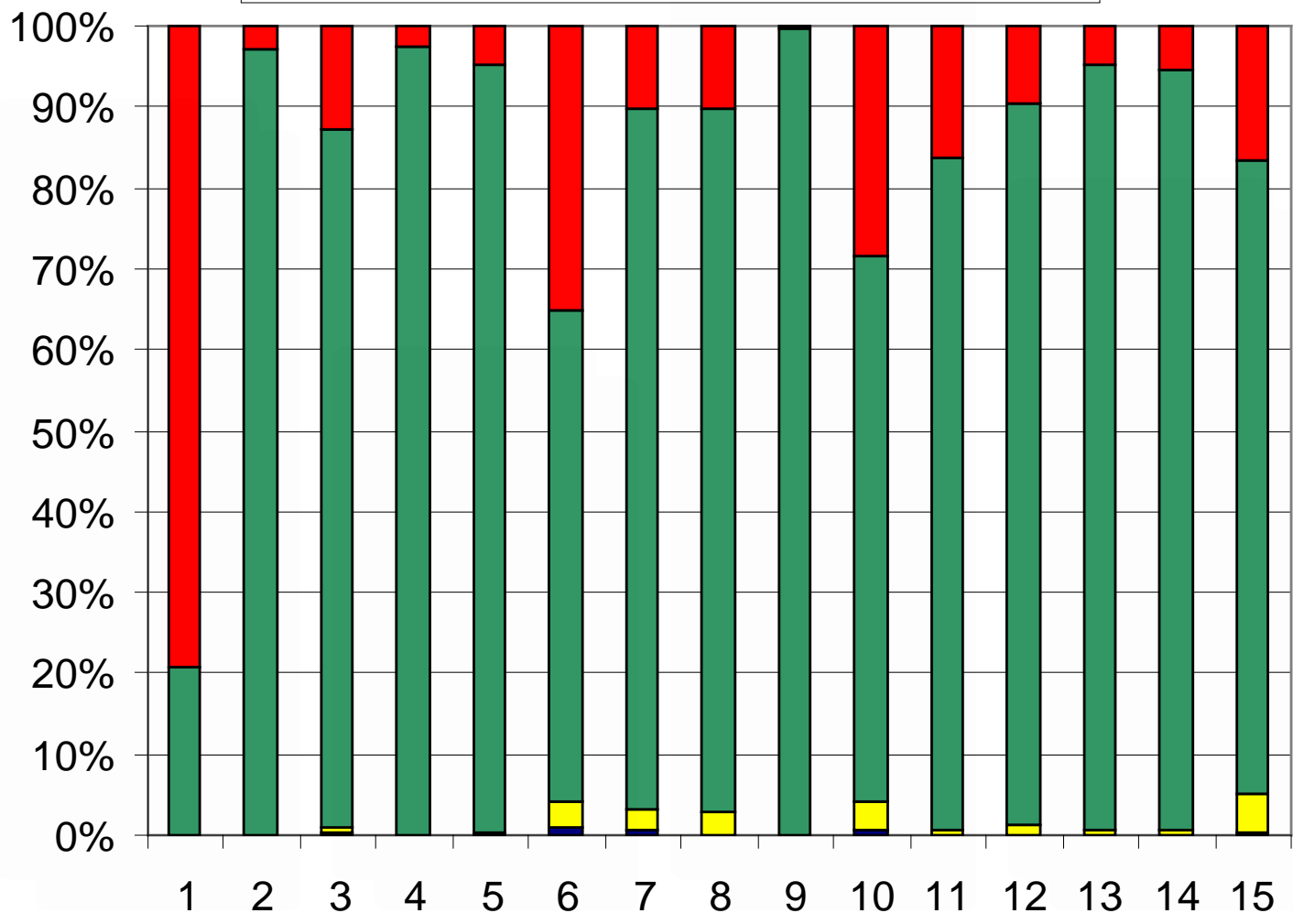


Control Period

■ <88% ■ 89-91% ■ 92-96% ■ 97-100%



Closed Loop Group



Autonomous Controllers

- Increase Safety?
- Improve Outcomes?
- Compensate for the austere/difficult environment
- Increase Capabilities of provider ?
 - Prompts
 - Feedback
 - Suggested treatment(s)
 - Algorithms of care



Future Areas of Autonomous Control

- Mechanical Ventilation
 - APRV, AC, SIMV
 - PEEP
 - Rate/ventilation
 - Weaning
- IV Fluid Control
 - Battlefield prior to hemorrhage control
 - Post-Op resuscitation
 - Burn patients
- Target Controlled infusion
 - Analgesia
 - Sedation
 - Anesthesia



Communication

Wireless
Pt.-caregiver
Pt.-receiving facility
Pt.-Regional Control

Add-on Modules

Powered by fire wire
USB port
Communicate with/coordinated by central CPU

Monitor

Ventilator

O2 Supply

Fluid Controller

Limited Power supply

Ultrasound

ICP/Lycox

Thermal Control

Pain Control

Defibrillator

Labs/ISTAT

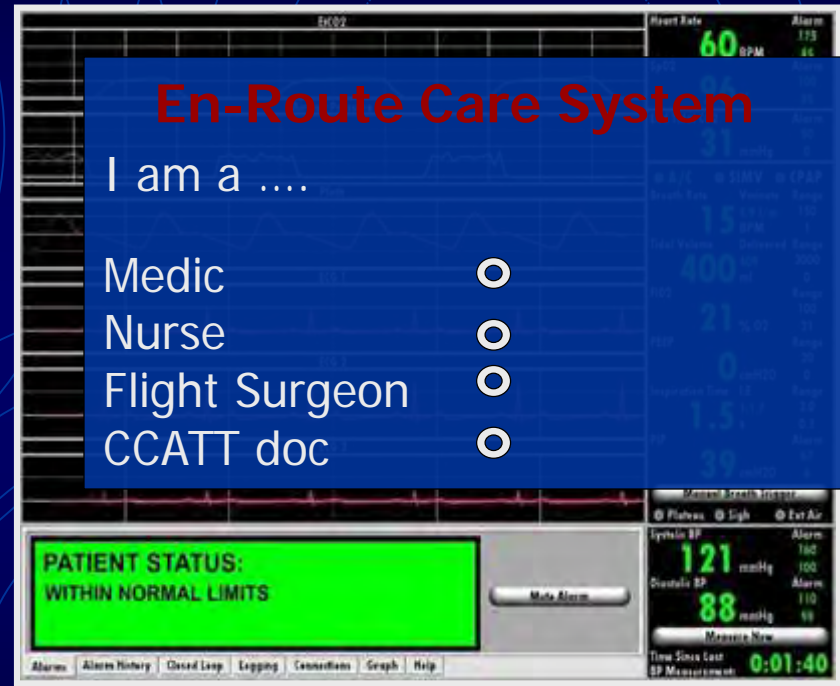


Suction module(s)

Battery Pack

Interface Research

- Context Sensitive
 - Provide cues based on monitored parameters
- Access to levels of sophistication
- Variable levels of autonomous control



Master Caution Light!

F-16 panel-
tells you
that
something
is wrong!

**TAKE
ACTION
QUICKLY!**



Master Caution for Shock

This could be
our
Master Caution
light for a
patient in
trouble



“He who desires to
practice surgery must
go to war”

Hippocrates

c. 460 BC – c. 377 BC



HAS CIVILIAN MEDICINE
BENEFITTED FROM
MILITARY MEDICINE?

Combat Surgical Innovations: What has worked in the past?

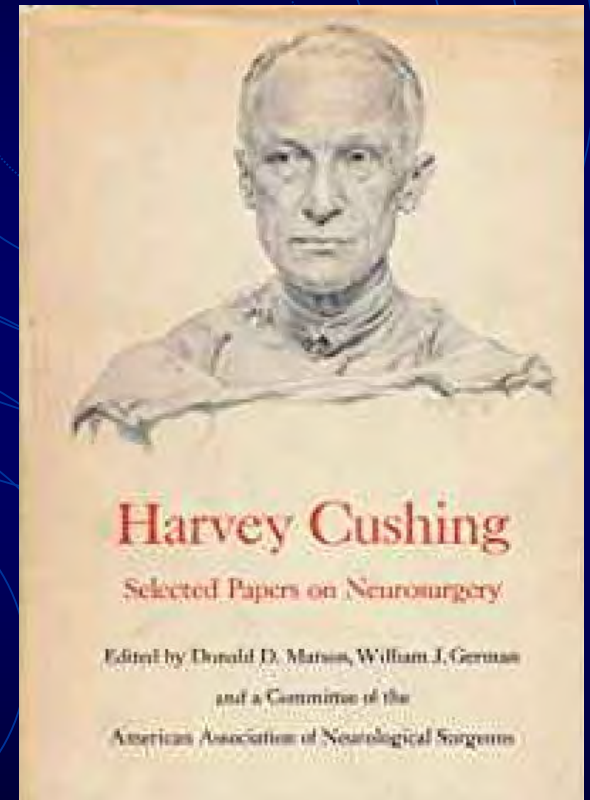
- Baron D. Larrey - ambulance system (Napoleonic wars)
- Florence Nightingale
 - nursing care (Crimea)



- Battlefield surgical units - US Civil War

Harvey Cushing

- Bovie cautery
- Father of neurosurgery
- WWI France



Combat Surgical Innovations: What has worked in the past?

WWI

- Fluid resuscitation for hemorrhagic shock
- Laparotomy for penetrating abdominal wounds
- Debridement: Depage

Combat Surgical Innovations: What has worked in the past?

WWII

- Surgical augmentation teams
- Training of corpsmen in early management of injuries
- Defined theater evacuation policies and echelons of care
- Blood & plasma transfusions
- IV antibiotics

Combat Surgical Innovations: What has worked in the past?

Korea

- Helicopter transport
- MASH Units
- Vascular anastomoses – F.C. Spencer



Combat Surgical Innovations: What has worked in the past? Viet Nam

- Vascular surgery in combat injuries codified (Norm Rich)
- Helicopter transport of injured dramatically improved
- Rapid surgical intervention => Sicker patients surviving
- Recognition of “Da Nang lung” = ARDS
- Experience in war surgery caused surge in trauma centers and systems in CONUS

Combat Surgical Innovations: What has worked in the past?

OEF/OIF

- Helicopter transport of injured perfected
- Resurgence of (appropriate) tourniquet use
- Hemostatic dressings
- Damage control surgery
 - Abdominal
 - Shunts for vascular injuries
 - Orthopedic – washout & external fixation
- Damage control resuscitation

Combat Surgical Innovations: What has worked in the past? **OEF/OIF**

- Massive transfusion protocols with 1:1:1 blood product ratios
- Autonomous controls translated into critical care protocols
- ACUTE CARE SURGERY
- WELL-TRAINED PREHOSPITAL PERSONNEL

Blood Product Administration

- Use of Whole Blood
 - Change in Philosophy
 - Screening
 - Whole Blood Drives
- Massive Transfusion
- Tracking of Products given
- Thromboelastography
- Guided resuscitation



Fresh Whole Blood Improves Survival Compared To Component Therapy

- 111 patients (55 Fresh Whole Blood [FWB] vs 56 Component Therapy [CT])
- All had a massive transfusion and ISS>15

- | | <u>FWB</u> | <u>CT</u> |
|-------------|---------------|---------------|
| • ISS | 25 (16-50) | 19 (16-35) |
| • Mortality | 21.8% (12/55) | 33.9% (19/56) |
- This represents a 15% absolute reduction in mortality or a 39% relative reduction in mortality
 - Variables included in analysis
 - ISS, admission (HR, SBP, INR, CBC, base deficit) total RBC, FFP, PLT, cryo transfused in 7 days, rFVIIa use
 - After adjusting for ISS, $p=.09$

Fresh Whole Blood Improves Survival Compared To Component Therapy

- 111 patients (55 Fresh Whole Blood [FWB] vs 56 Component Therapy [CT])
- All had a massive transfusion and ISS>15

- | | <u>FWB</u> | <u>CT</u> |
|-------------|---------------|---------------|
| • ISS | 25 (16-50) | 19 (16-35) |
| • Mortality | 21.8% (12/55) | 33.9% (19/56) |
- This represents a 15% absolute reduction in mortality or a 39% relative reduction in mortality
 - Variables included in analysis
 - ISS, admission (HR, SBP, INR, CBC, base deficit) total RBC, FFP, PLT, cryo transfused in 7 days, rFVIIa use
 - After adjusting for ISS, p=.09

Preliminary Experience with Thromboelastography (TEG)

- Over 4 months in 2004 in Iraq
 - >1200 trauma evaluations; >1000 surgical procedures
 - >1700 units blood products administered
 - Only 30 doses of rVIIa given
- Now theater-wide use by protocol

TEG-Guided Resuscitation

Abnormal TEG

Prolonged R time

Transfuse 4 units FFP

Decreased Maximum Amplitude


Transfuse 2-4 units Whole Blood

**Prolonged K time
or Decreased α -Angle**

Transfuse 4 units FFP then 4 units Cryoppt/rVIIa if remain abnormal

Increased LY30

**Amicar 5 gm IV load over one hour
then 1 gm/hr until LY30 normal**



TEG-guided resuscitation is
now built into the Massive
Transfusion Protocols of many
civilian trauma centers across
the U.S. and Europe

The (Very Near) Future

- The warfighter/patient deserves the very best
- Improvements in technical capabilities offer a significant opportunity to enhance the care and outcome of the injured soldier
- Implications and applications for civilian trauma care are limited only by our imagination, ingenuity, and the integration of military trauma care into the civilian medical system

The (Very Near) Future

- The warfighter/patient deserves the very best
- Improvements in technical capabilities offer a significant opportunity to enhance the care and outcome of the injured soldier
- Implications and applications for civilian trauma care are limited only by our imagination, ingenuity, and **the integration of military trauma care into the civilian medical system**

Senior Visiting Surgeon Program

- Initially conceived as a means of sharing information and mentorship
- Presented to the Executive Committee of the ACS COT in 2005
- Jointly sponsored by...
 - ACS
 - ACS COT
 - AAST



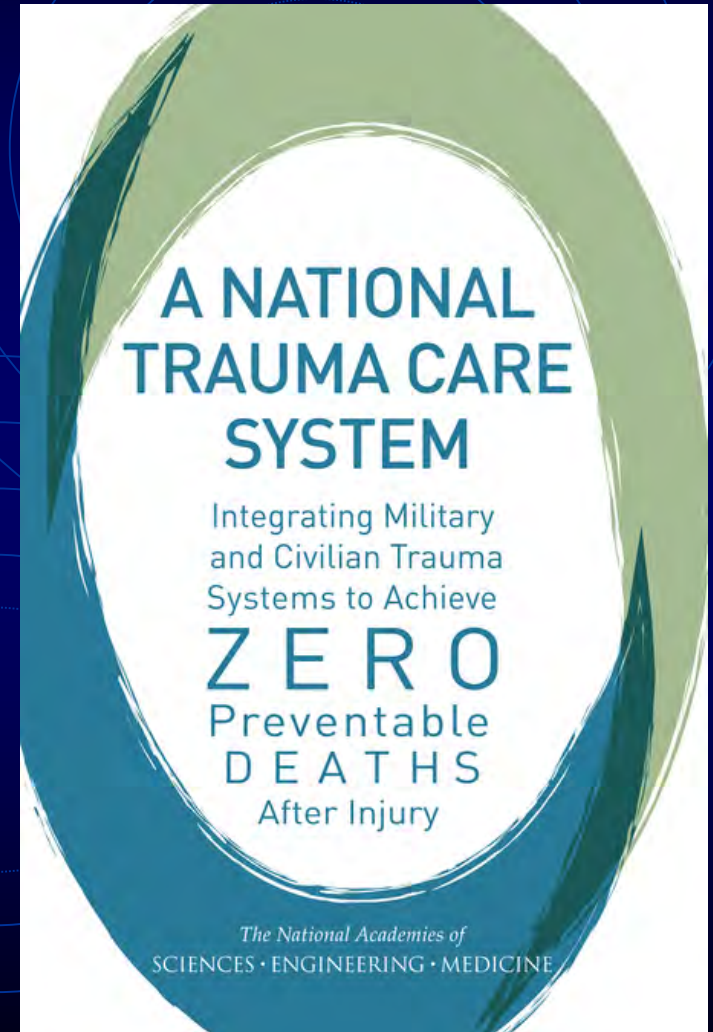
SVS Overview

- Two to four week rotation
- Clinical involvement in the ICU, OR and all aspects of care
- Mentorship of military surgeons & staff
- Grand Rounds
- Bring home the lessons learned



A Bold New Mandate

- National Academies of Sciences, Engineering, and Medicine



*“If I have seen a little further
it is by standing on the
shoulders of Giants”*

Sir Isaac Newton 1676

COL David G. Burris, MD, FACS
1955 - 2010



Jay Johannigman, COL, USAF



Donald Trunkey, MD, FACS COL (Ret) USA





President Ronald Reagan

“Duty, honor, country -- the motto of West Point. And like the men and women of West Point and all of our military institutions, our physicians in uniform have never failed us. They've been ready when called; ready for hardship and sacrifice, for adventure and exploration; ready to extend the hand of compassion and healing care; ready, if called, to give the last full measure of their devotion”

**MAJ Mark D. Taylor, 41
Stockton, CA killed 20 MAR 2004**



COL Brian D. Allgood
West Point, NY killed 20 JAN 2007



MAJ John Pryor, 42

Philadelphia, PA killed 25 DEC 2008



".... Seek always to do some good, somewhere. Every man has to seek in his own way to realize his true worth. You must give some time to your fellow man. Even if it's a little thing, do something for those who need help, something for which you get no pay but the privilege of doing it. For remember, you don't live in a world all your own. Your brothers are here, too."

Albert Schweitzer

THANK YOU!



Questions?





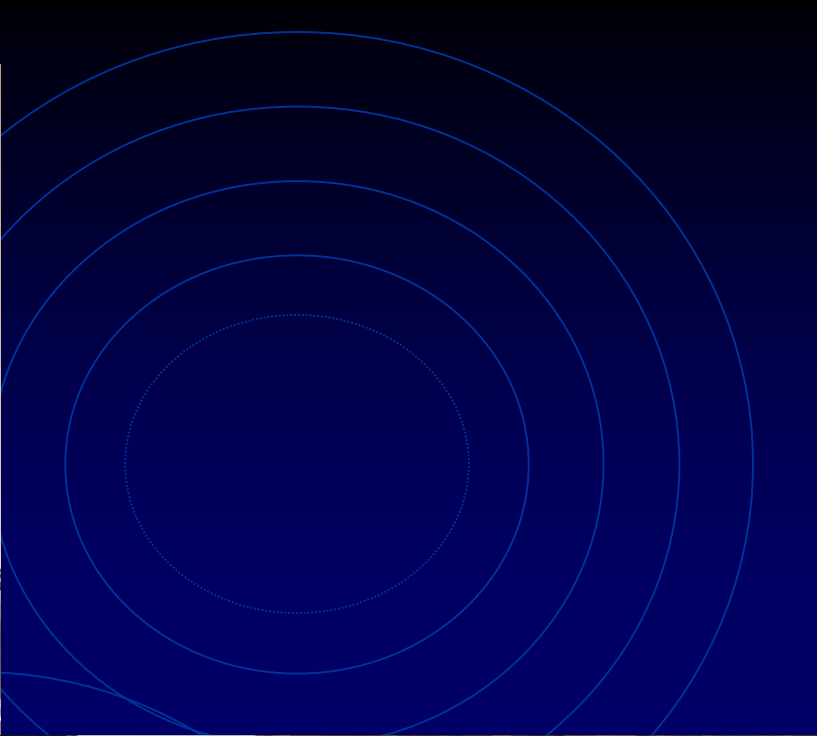
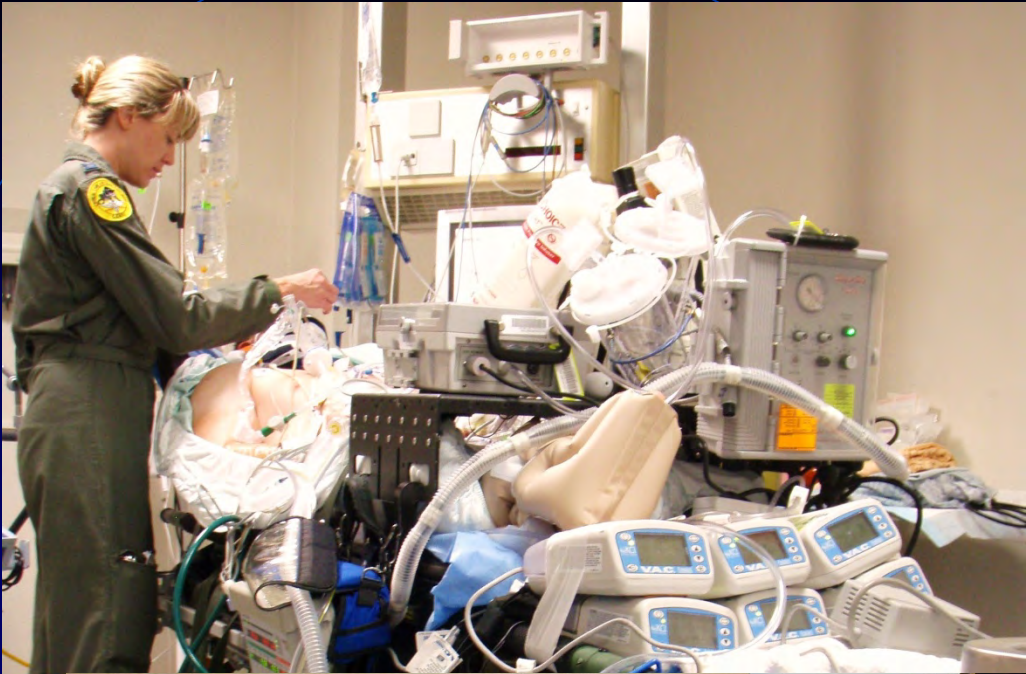
President Ronald Reagan

- “...even while under fire, military physicians developed the use of massive blood transfusions in treating shock and trauma. They pioneered burn research and treatment. And again, of course, ... continues the tradition, leading in such areas as research on vascular surgery and reconstruction”





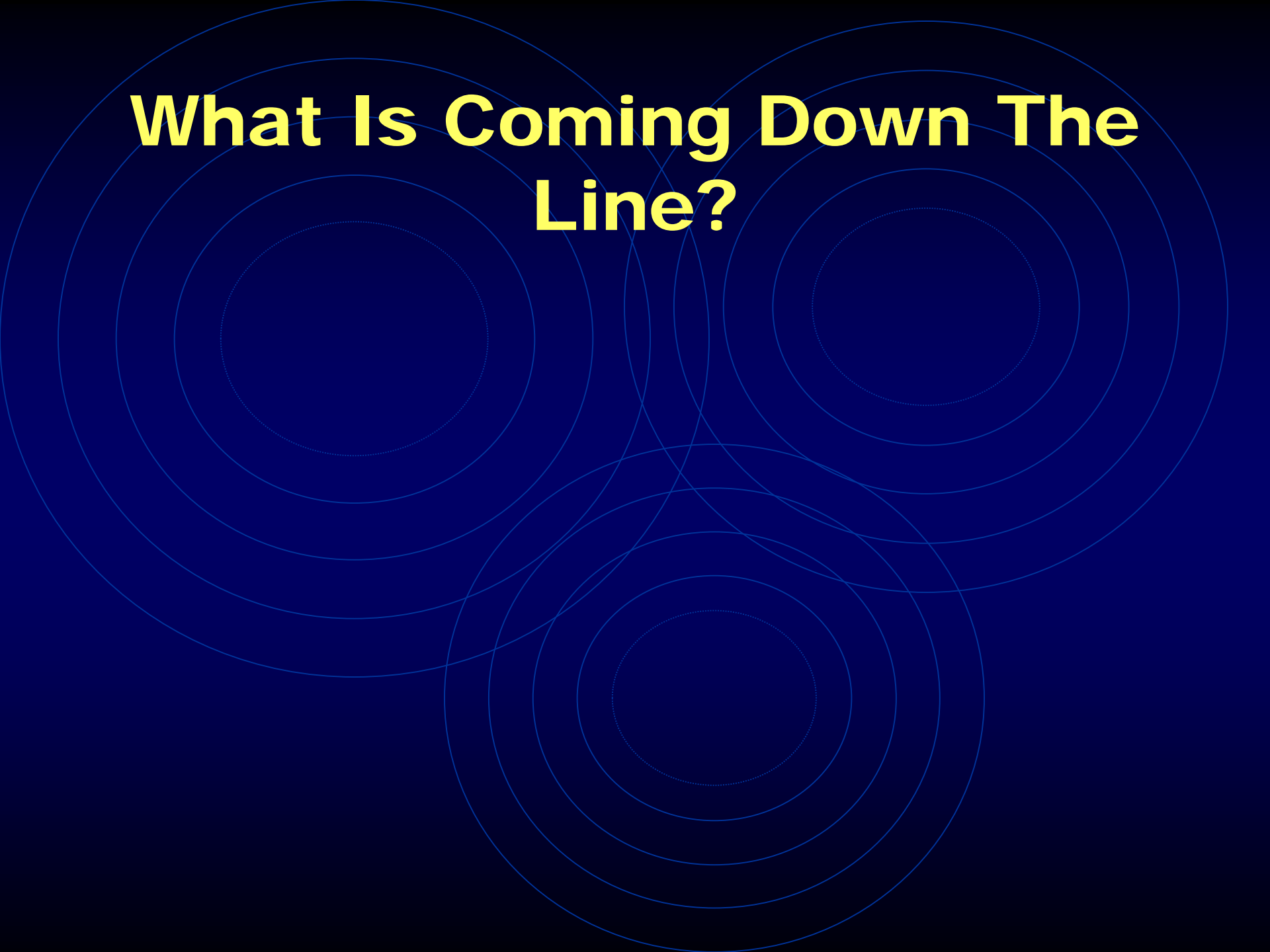








What Is Coming Down The Line?

The background features a dark blue field with several overlapping circles and lines. Three large, light blue circles are arranged in a triangular pattern, each containing a smaller, dotted light blue circle. A network of thin, light blue lines crisscrosses the background, creating a complex, web-like pattern that intersects with the circles.