Future role of ECMO Far Forward

How FAR should we go?

I have no financial disclosures

These are MY OPINIONS and do not represent any sort of statement by the USAF or DOD

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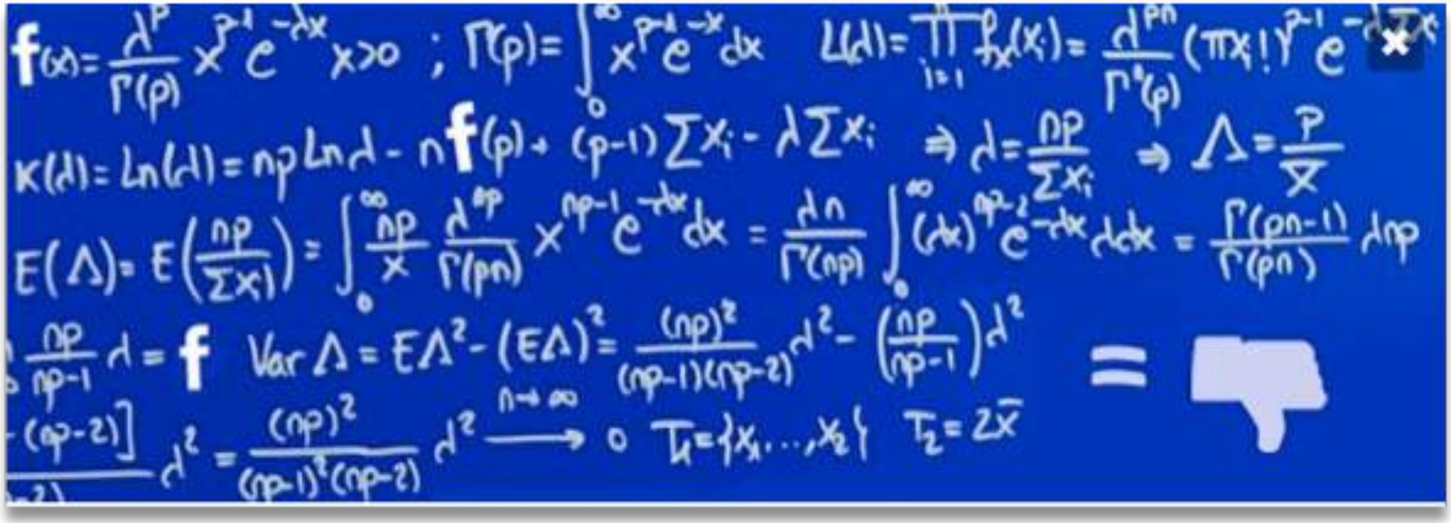
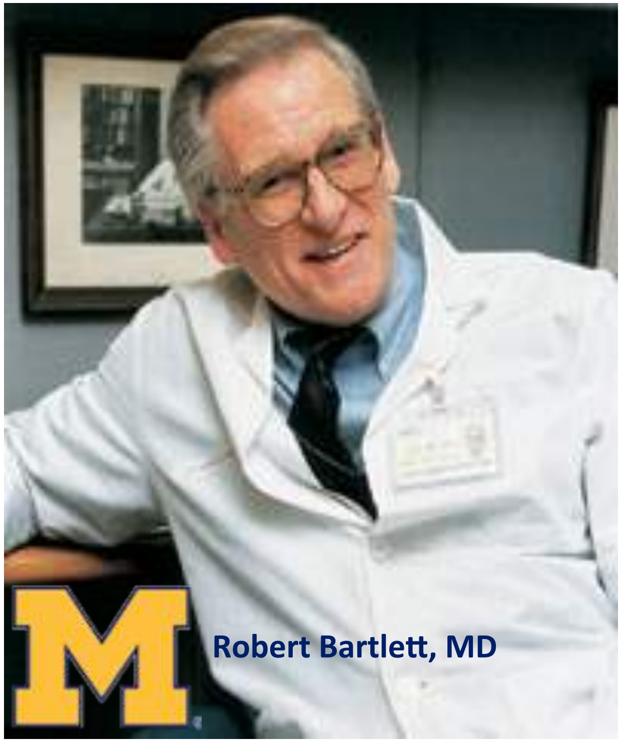
Penn Medicine

ECMO in general and far forward in particular...



Acknowledgments



Optimal Strategies for Severe Acute Respiratory Distress Syndrome

Jeremy W. Cannon, MD, SM[a,*], Jacob T. Gutsche, MD[b], Daniel Brodie, MD[c]

CC Clin NA. Jan 2017

DoD Members

- Warren Dorlac, Gina Dorlac
- Pat Allan, Erik Osborn
- Ray Fang, David Zonies
- Matt Bacchetta
- Lee Cancio, Andrew Batchinsky

First Far-Forward Cases

Index cases

- Dorlac 2006
- Bacchetta 2009
- Wanek 2010


332 AF Theater Hospital
Balad Air Base, Iraq

Overview

Getting started

- Definitions/Indications
- Historic Context
- Needs Assessment & Buy-In
- Infrastructure

Keeping it running

- More Buy-In
- More Infrastructure
- Sustainment

Moving forward

Definitions/Indications


Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Extracorporeal membrane oxygenation in severe trauma patients with bleeding shock☆

Matthias Arlt*, Alois Philipp, Sabine Voelkel, Leopold Rupprecht, Thomas Mueller, Michael Hilker, Bernhard M. Graf, Christof Schmid

University Hospital Regensburg, Germany

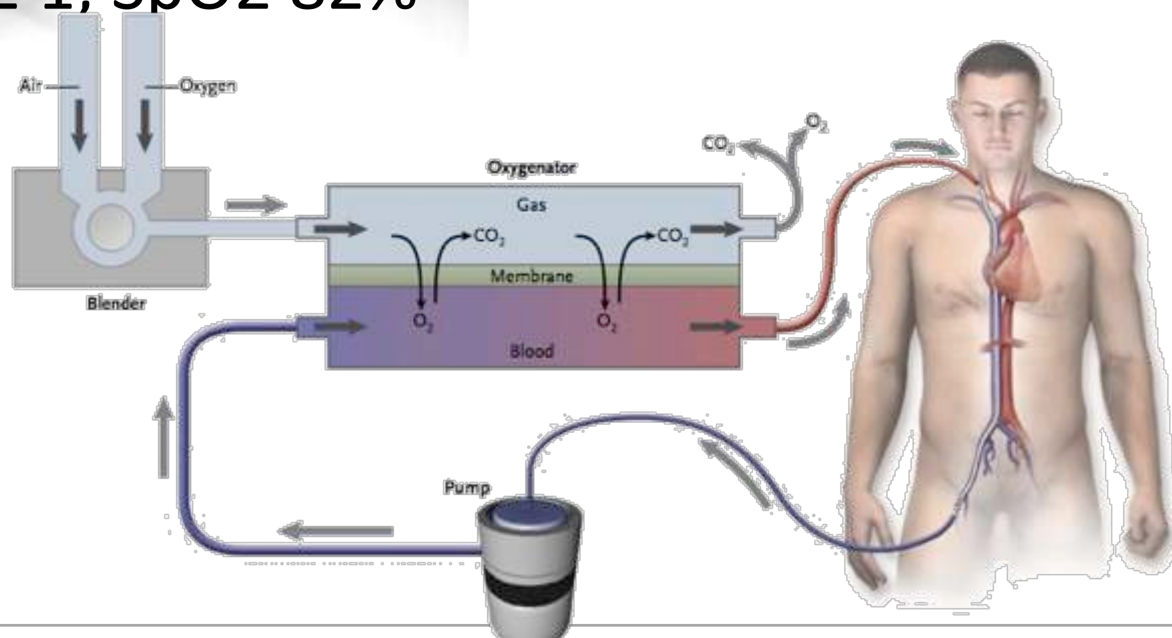
Resuscitation 2010; 81: 804-9.

Definitions/Indications

pHI 38, FiO2 1, SpO2 82%

VV ECMO

- Respiratory Support
- Rapidly Correct ABG
- Reduce Vent Settings



NEJM 2011; 365: 1905-14.

Historic Context

Post-Trauma ARDS, 1971

Extracorporeal Life Support Organization
Courtesy, Dr. Robert Bartlett

Historic Context

1977 Bob Bartlett, 2 Bread Trucks, and a C-130

Historic Context

1986 Maj Devin Cornish
1st ECMO Transport Program

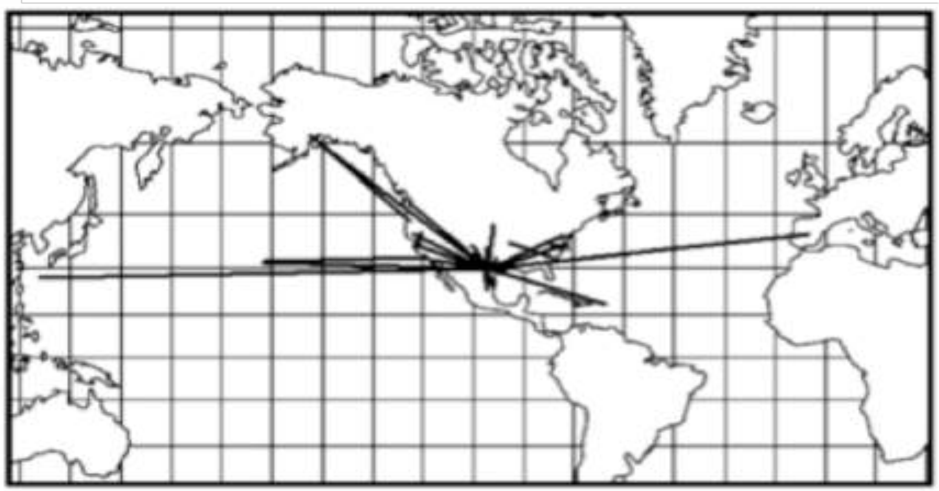

A 22-year experience in global transport extracorporeal membrane oxygenation

Christopher P. Coppola[a,*], Melissa Tyree[b], Karen Larry[b], Robert DiGeronimo[b]

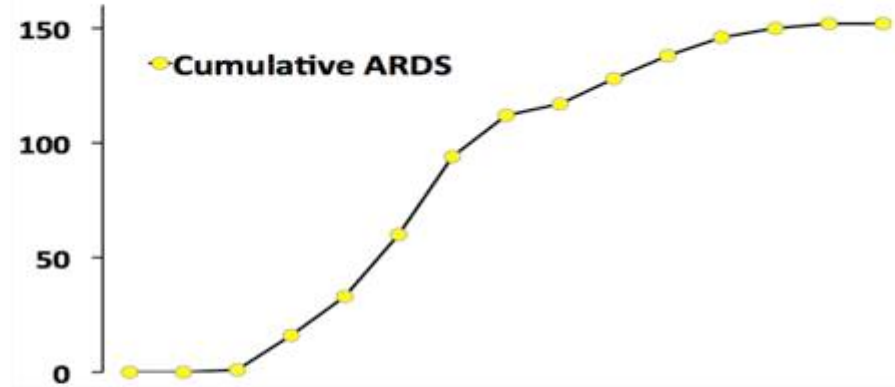
[a]Department of Surgery, Wilford Hall Medical Center, San Antonio, Lackland AFB, TX 78236, USA
[b]Department of Neonatology, Wilford Hall Medical Center, San Antonio, TX, USA

Received 28 August 2007; accepted 2 September 2007

Journal of Pediatric Surgery (2008) 43, 46–52

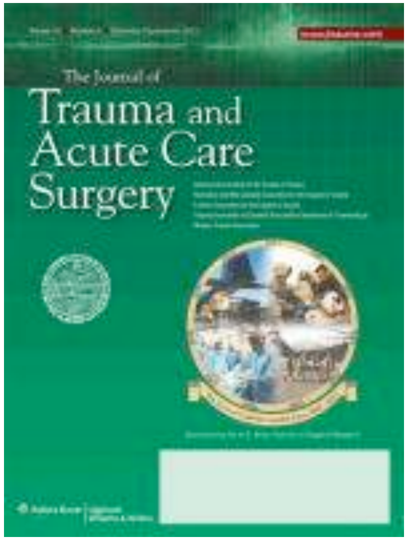


Needs Assessment



2001 2009

Needs Assessment



"DOW"

Figure 4. Mechanism of death in PS cases.

JTrauma 2011. 71:S4-8.

If bleeding doesn't get you, MSOF will.

Table 1. Why Do Trauma Patients Die?

	Acute (<48 hours), %	**Early (48 hours to 7 days), %**	**Late (>7 days), %**
Brain injury	40	64	39
Blood loss	55	9	0
MOFS	1	18	61

MOF, multiple organ failure.
(Adapted from data from Sauaia A, Moore FA, Moore EE, et al. Epidemiology of trauma deaths: a reassessment. J Trauma 1995; 38:185–193, with permission.)

Needs Assessment

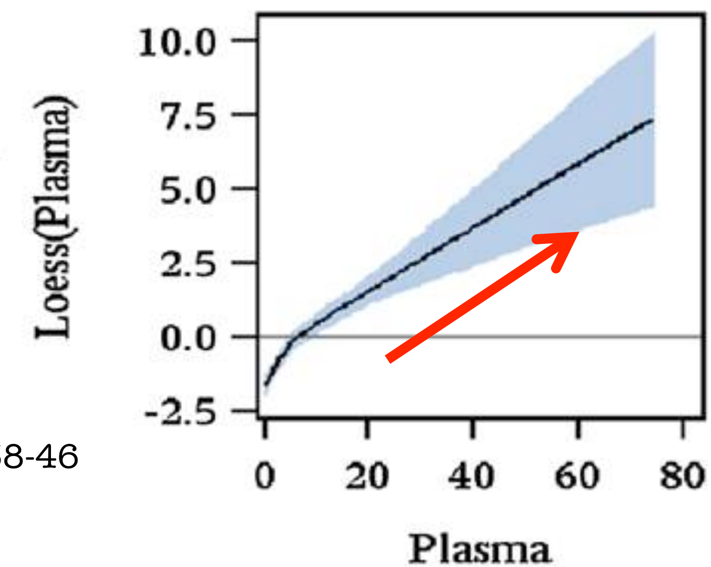
- **ARDS in 6.4% intubated casualties**
- **Risks are female, high ISS, and shock**
- **Plasma & Crystalloid increase ARDS**
- **OR for Death = 4.8**

ORIGINAL ARTICLE

Transfusion strategies and development of acute respiratory distress syndrome in combat casualty care

Pauline K. Park, MD, Jeremy W. Cannon, MD, SM, Wen Ye, PhD, Lorne H. Blackbourne, MD, John B. Holcomb, MD, William Beninati, MD, *and* **Lena M. Napolitano, MD,** *Ann Arbor, Michigan*

J Trauma and ACS (2013) 75:S238-46



Needs Assessment

ORIGINAL ARTICLE

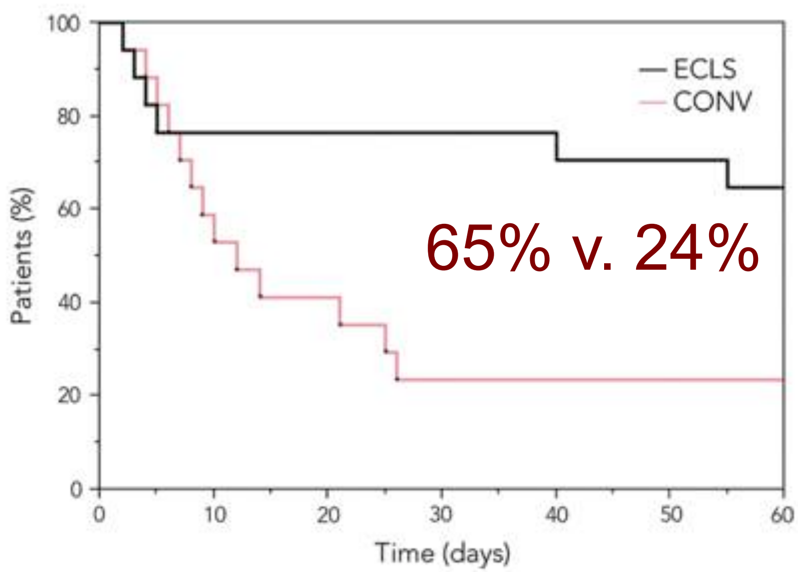
Venovenous extracorporeal life support improves survival in adult trauma patients with acute hypoxemic respiratory failure: A multicenter retrospective cohort study

Derek M. Guirand, MD, Obi T. Okoye, MD, Benjamin S. Schmidt, MD, Nicky J. Mansfield, BS, James K. Aden, PhD, R. Shayn Martin, MD, Ramon F. Cestero, MD, Michael H. Hines, MD, Thomas Pranikoff, MD, Kenji Inaba, MD, *and* **Jeremy W. Cannon, MD,** *San Antonio, Texas*

JTrACS 2014. 76(5):1275-81.

TABLE 2. Mortality Analysis

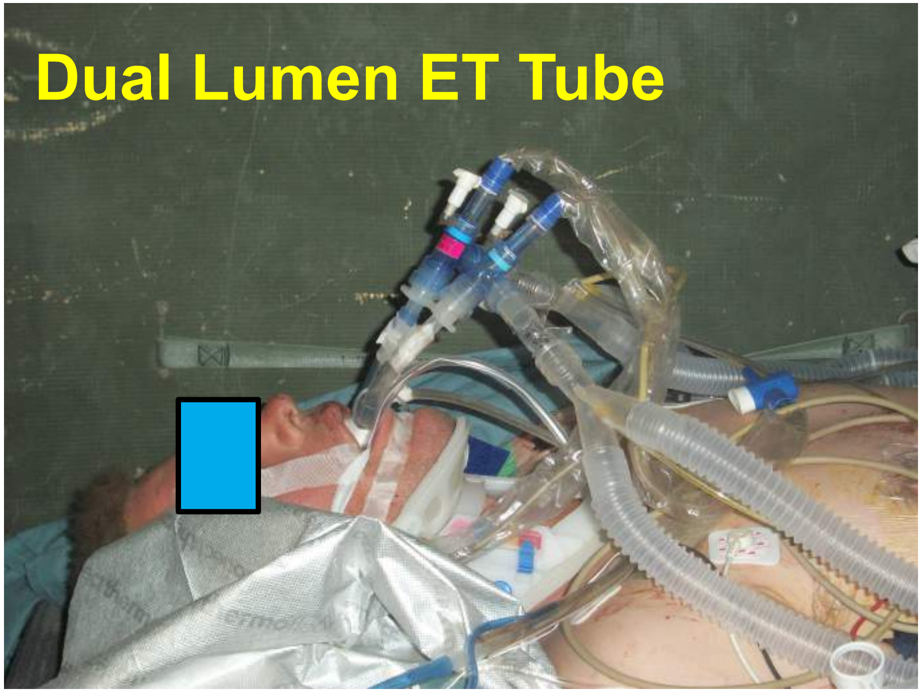
	AOR (95% CI)	*p*
Full cohorts		
ECLS	0.193 (0.042–0.884)	0.034
Chest AIS	0.693 (0.496–0.967)	0.031
ISS	1.112 (1.056–1.171)	<0.001
Pre-ECLS fluid balance	1.156 (1.022–1.309)	0.022
LIS	10.939 (1.805–66.305)	0.009
Matched cohorts		
ECLS	0.038 (0.004–0.407)	0.007
ISS	1.123 (1.029–1.226)	0.009



Needs Assessment

CCATT Capability

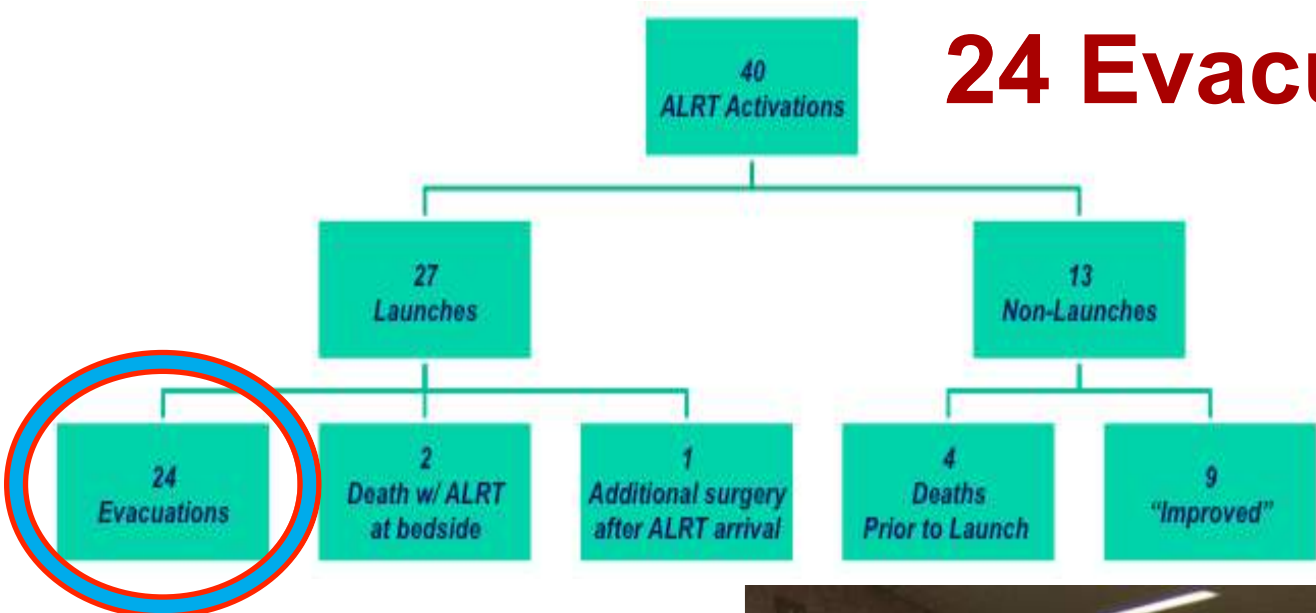
- Paralytics and the 754
- No iNO, No proning, No advanced vent
- Patients marooned in level III or died

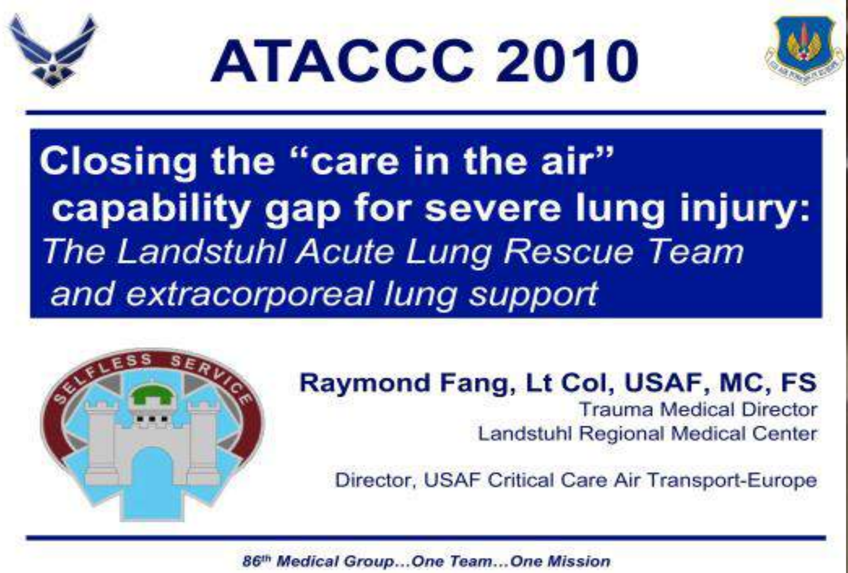


Courtesy LtCol (Dr.) Phil Mason

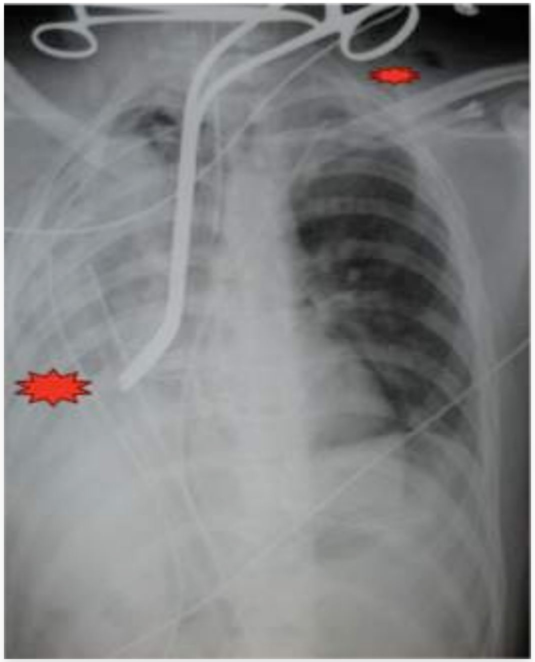
Infrastructure

24 Evacuations





Infrastructure



OCT 2010

Results

WTA 2012 PLENARY PAPER

Transportable extracorporeal lung support for rescue of severe respiratory failure in combat casualties

Thomas Bein, MD, PhD, David Zonies, MD, MPH, Alois Philipp, Markus Zimmermann, MD, Erik C. Osborn, MD, Patrick F. Allan, MD, Michael Nerlich, MD, PhD, Bernhard M. Graf, MD, PhD, *and* **Raymond Fang, MD,** *Regensburg, Germany*

JTrauma ACS. Dec 2012; 73(6): 1450-6.

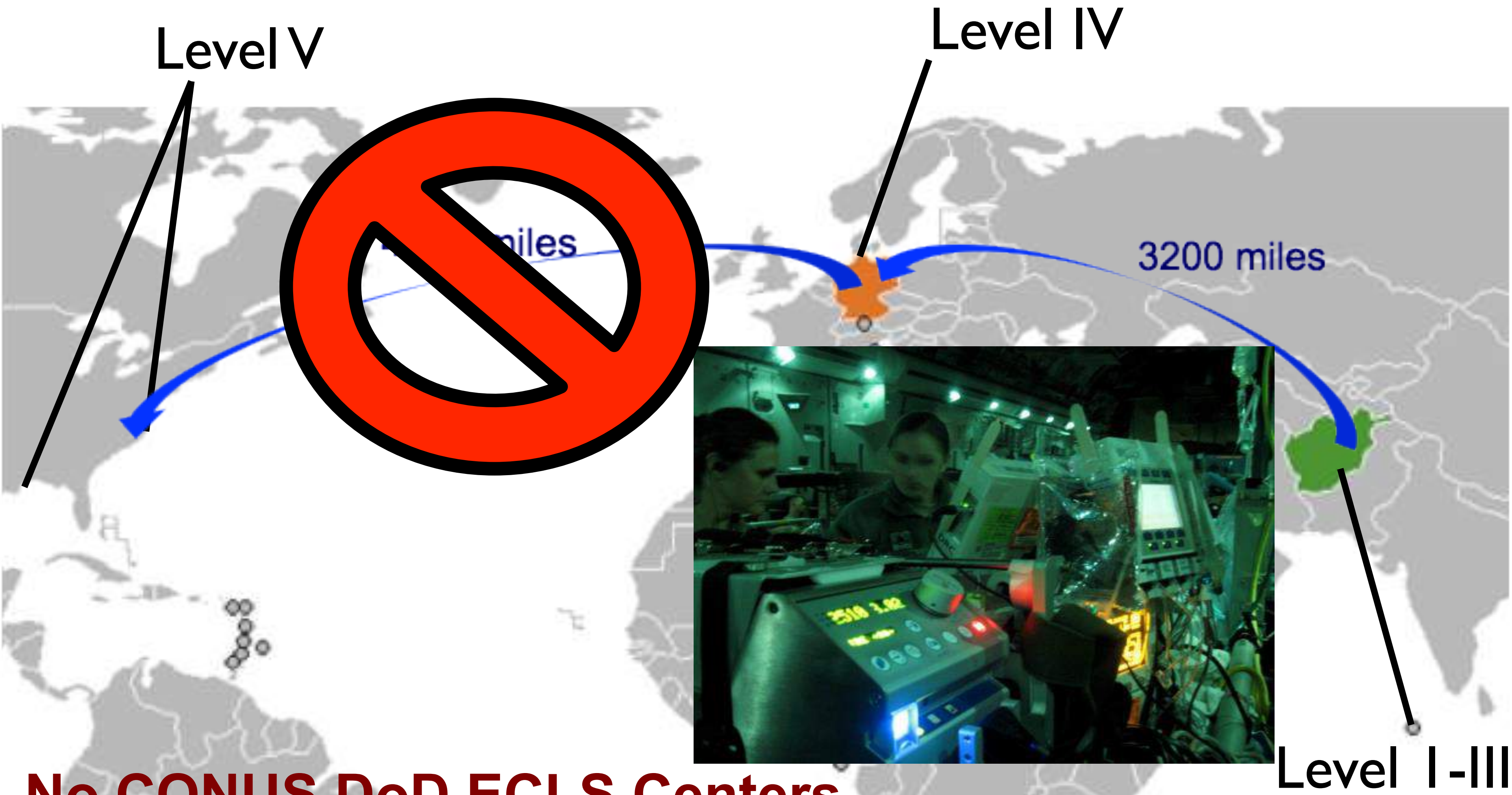
TABLE 2. Patient and Injury Characteristics, ECLS Use, and Outcomes

Patient	Age, y	Primary Injury	Pulmonary Injury	ISS	AIS Score (Chest)	APACHE II Score	ECLS Device	ECLS Duration, d	Outcome
1	24	Blast injury with bilateral lower-extremity amputations	Blast-related bilateral pulmonary contusions, pneumonia	13	3	N/A	PECLA	12	Survived
2	23	Blast injury with traumatic brain injury	No primary lung injury	22	0	34	PECLA	8	Survived
3	33	Blast injury with left lower-extremity amputation	Blast-related bilateral pulmonary contusions, wound sepsis	34	3	37	PECLA	9	Died
4	23	Blast injury with traumatic brain injury	Blast-related bilateral pulmonary contusions	17	1	26	PECLA	8	Survived
5	19	Gunshot to right chest	Right pneumonectomy	33	4	29	PECLA	18	Survived
6	20	Motor vehicle collision with spinal cord injury	Bilateral pulmonary contusions	33	5	24	ECMO	7	Survived
7	29	Blast injury with traumatic brain injury	Bilateral pulmonary contusions, aspiration	34	3	31	ECMO	8	Survived
8	25	Gunshot to right chest	Right pulmonary contusion	9	3	20	ECMO	7	Survived
9	22	Gunshot to right chest	Right pneumonectomy	34	5	21	ECMO	13	Survived
10	21	Gunshot to left chest	Left pulmonary contusion	14	3	12	ECMO	6	Survived

AIS, Abbreviated Injury Scale; APACHE, Acute Physiology and Chronic Health Evaluation; ISS, Injury Severity Score; N/A, not available.

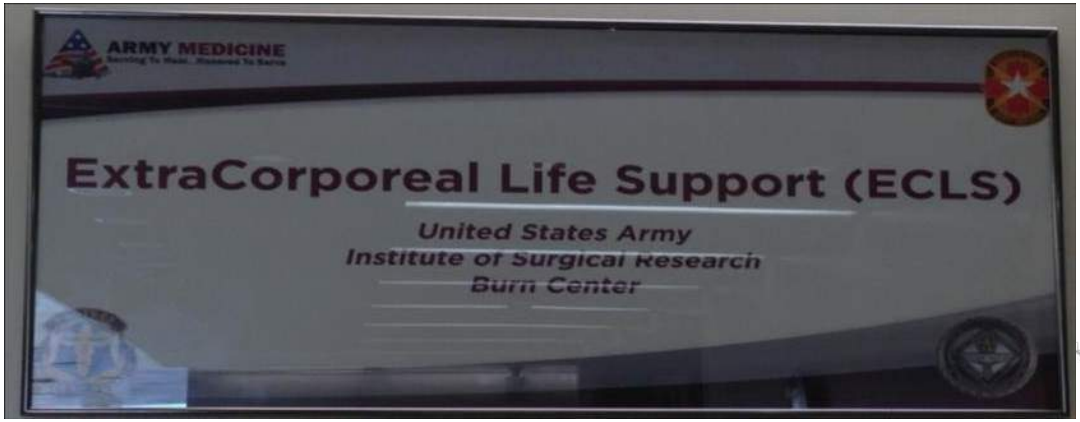
US Only (Not including NATO allies)

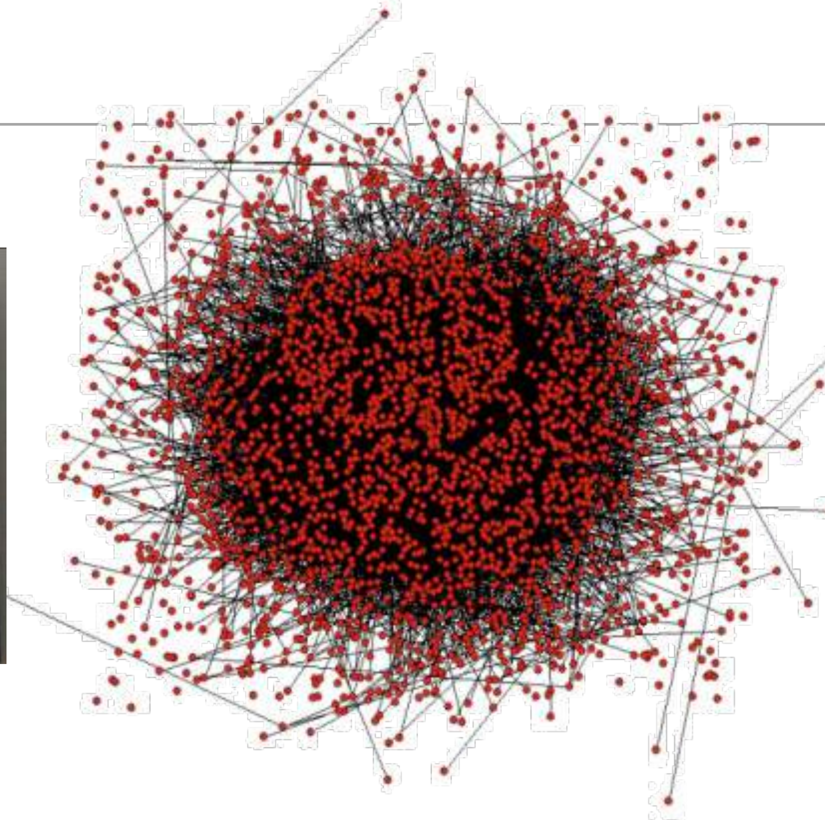
Keeping It Running



No CONUS DoD ECLS Centers
No CONUS Transport Team

More Buy-In


ARMY MEDICINE
ExtraCorporeal Life Support (ECLS)
United States Army
Institute of Surgical Research
Burn Center




Safety In The Heart Of Danger
SAMMC ADULT ECLS
ACUTE LUNG RESCUE TEAM
UT SERVO VITAS


Burn ICU

More Infrastructure

Didactics
- ELSO Course
- WHMC Course

Training
- Animal Lab
- Clinical Cases

Sustainment

CONUS PROGRAM	TRANSPORT PROGRAM	FORWARD REACH
		

- 49 cases from Sep 2012-Apr 2017
- 30 in the last 16 months
- 590 ECLS days
- 30 transports (fixed wing + ground)
- 1 bridge to transplant
- 1 transport out of Afghanistan
- 65% survival to discharge

Sustainment—2013 Bridge to TXP

Pre-Transplant

German Civ→

LRMC→SAMMC→UH, San Antonio

Post-Transplant

October 2013

Sustainment—2016 Bagram, Afg

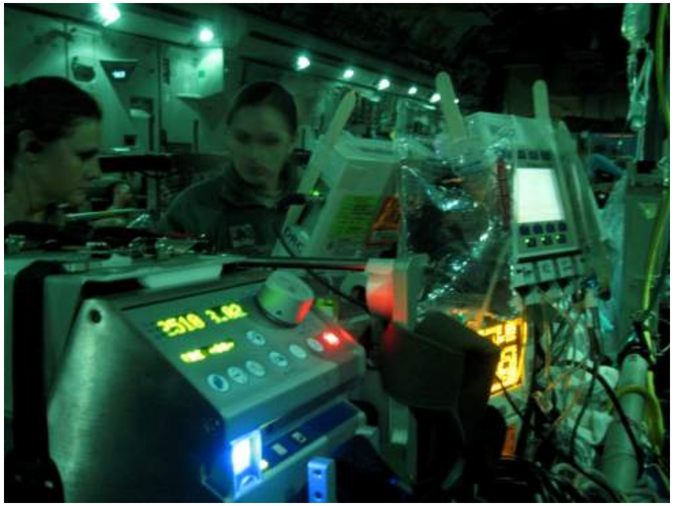
46 yo UK contractor

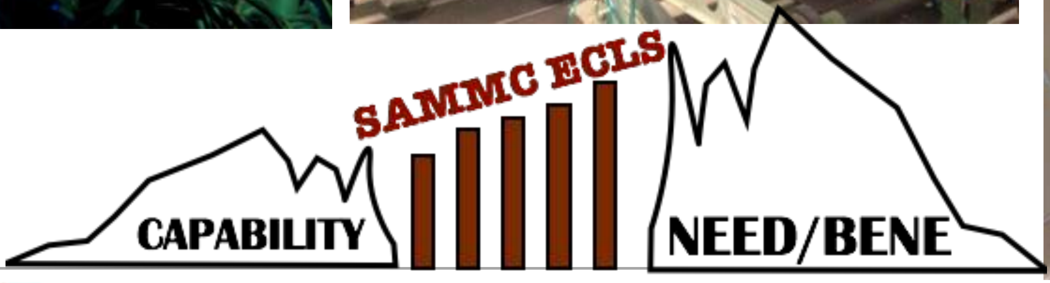
Influenza B + S. aureus PNA

Sustainment—2016 Bagram, Afg

BAF→LRMC→Leicester, UK


Safety In The Heart Of Danger
SAMMC ADULT ECLS




SAMMC ECLS
CAPABILITY
NEED/BENE

Looking Forward

- Stable base of operations (SAMMC)
- ECMO Program Leadership Pipeline
- ECMO as AF (DOD) Doctrine

BY ORDER OF
THE SECRETARY OF THE AIR FORCE

AIR FORCE TACTICS, TECHNIQUES
AND PROCEDURES 3-42.XX

Date

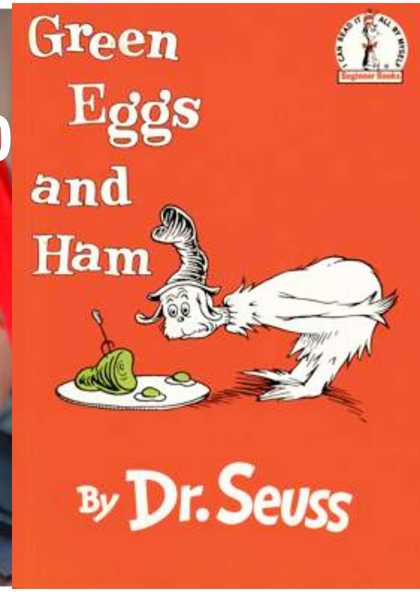
Tactical Doctrine

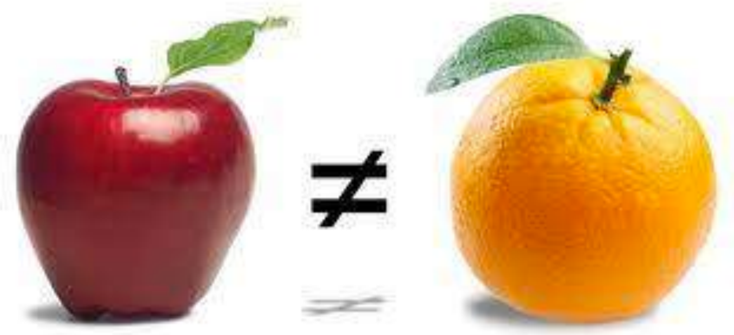
Acute Lung Rescue Team (ALRT)

ACCESSIBILITY: Publications and forms are available on the e-Publishing website at www.e-Publishing.af.mil and on the Air Mobility Command SG (AMC/SG) Manpower & Equipment Force Packaging (MEFPAK) SharePoint at: https://cs3.eis.af.mil/sites/27468/default.aspx

RELEASABILITY: There are no release restrictions on this publication.

Looking Forward





Resp Failure, Not Cardiac Arrest

Time on Vent (Level III)

Distance (CONUS ECMO team)

Looking Forward

- Forward Reach: <u>FOCUS ON ROLE III Capability</u>
  - Early Recognition: ARDS CPG
  - "Bridge" Solutions
  - Pre-position equipment/supplies
  - ECMO Physicians
  - ECMO Support Staff

Future role of ECMO Far Forward

How FAR should we go?

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