Joint
En Route Care

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20 April 2016

Purpose

- To describe the Joint En Route Care Environment
- To increase the knowledge about En Route Care platforms
- To describe En Route Care challenges (research gaps)
- To present some key ongoing efforts to support En Route Care clinicians
- To characterize the important elements of getting clearance for use in an en route care environment (airworthiness)

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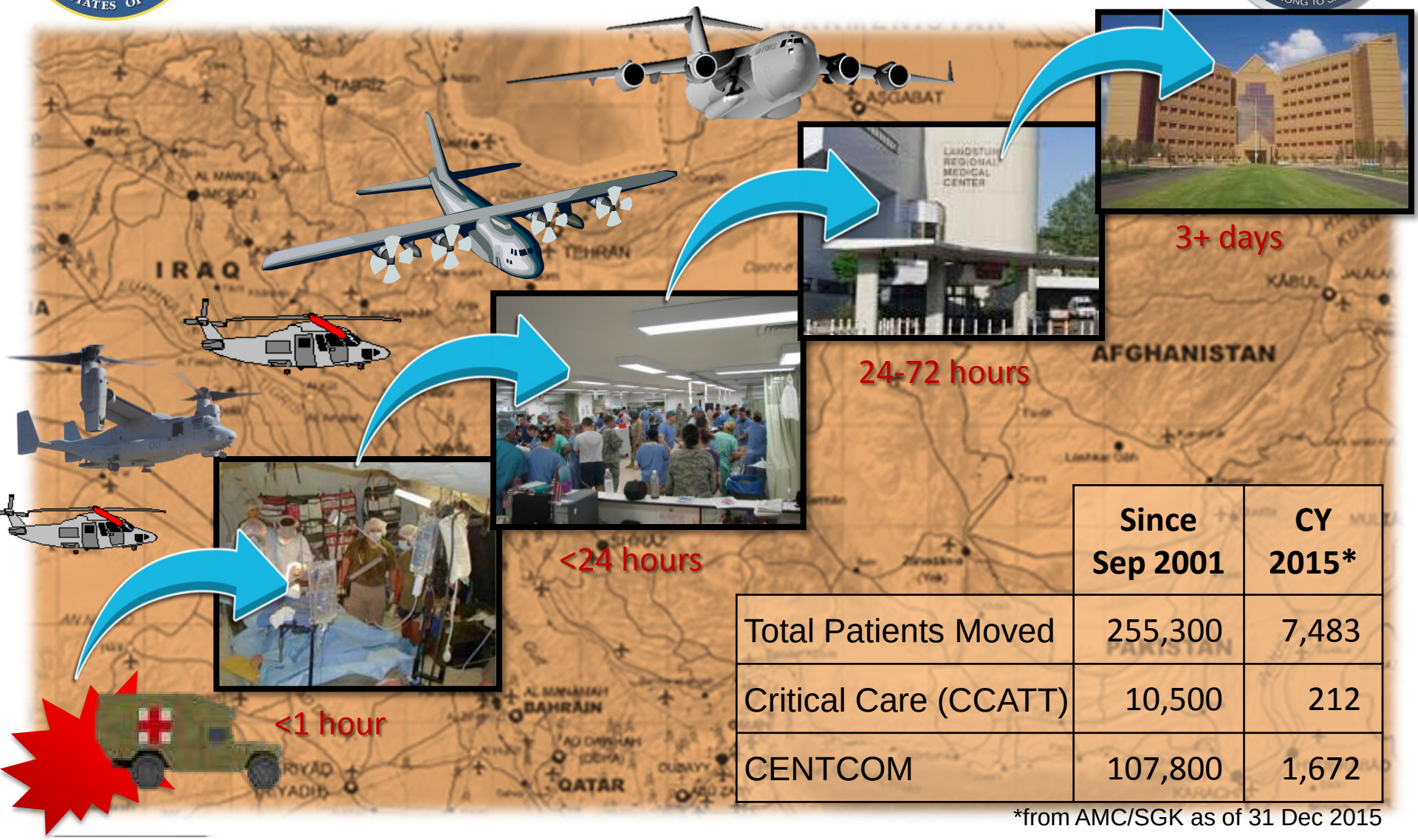
Current Continuum of Care



	Since Sep 2001	CY 2015*
Total Patients Moved	255,300	7,483
Critical Care (CCATT)	10,500	212
CENTCOM	107,800	1,672

*from AMC/SGK as of 31 Dec 2015

Future Continuum of Care

Panel Presentations

- U.S. Army – MEDEVAC & Transport Telemedicine
- U.S. Marine Corps – Seabasing & MV-22
- U.S. Navy – Automated Critical Care System
- U.S. Air Force – Strategic Aeromedical Evacuation
- Developing En Route Care Medical Devices for En Route Care

Transport Telemedicine System Aeromedical Evacuation

Todd Bishop

PjM Medical Evacuation/Mission Equipment Package

US Army Medical Research and Materiel Command

20 April 2016

Purpose

To increase understanding of Transport Telemedicine System

- Electronically capture medical informatics
- Integration effort
- Keep the flight paramedic's hands on the patient

HH-60M BLACK HAWK

Mission Equipment

External Electric Rescue Hoist

Environmental Control System

Aircraft Oxygen Generating System

Personnel Location System

Improved Crew Window (P3di)

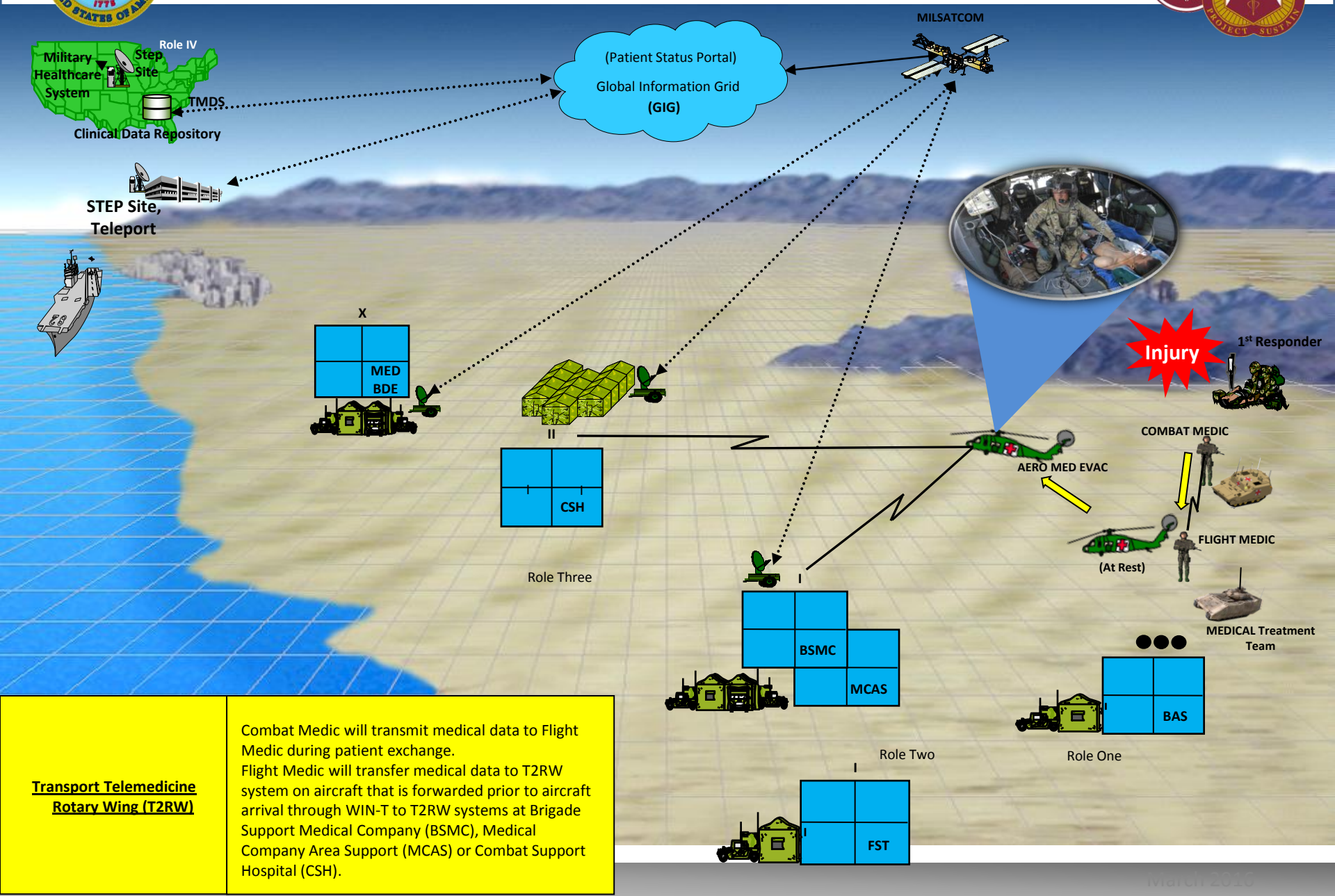
FLIR

Multi-Functional Crew Seat

Variable Position Litter System

Additional Medical Equipment

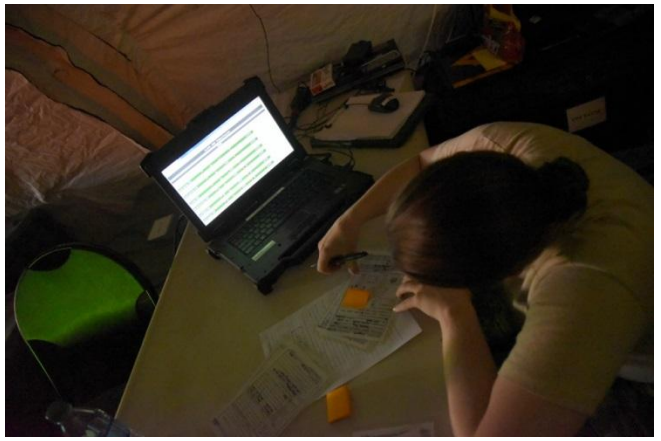
Transport Telemedicine OV-1



Transport Telemedicine Rotary Wing (T2RW)	Combat Medic will transmit medical data to Flight Medic during patient exchange. Flight Medic will transfer medical data to T2RW system on aircraft that is forwarded prior to aircraft arrival through WIN-T to T2RW systems at Brigade Support Medical Company (BSMC), Medical Company Area Support (MCAS) or Combat Support Hospital (CSH).

Objective

- Alleviate the flight medics burden – voice to text in high noise area
- Tele-mentoring – communication from physician allows medic to do more
- “Real time” situational awareness at hospital
- Integrating data into electronic health record
- Logistics and tracking
- Patient physiological data and documented medical care can be gathered as part of the medical evacuation in real time
- Data can be coded and stored within data servers at a remote location via world-wide-web



When the medic is busy saving a life the system is providing situational awareness to the receiving Medical Treatment Facility

Key Elements

1. Electronically capture medical informatics
   - Improve situational awareness
   - Document care closer to point of injury
2. Integration effort
   - On board medical devices
   - On board communications
3. Priorities
   - *Store and forward*
   - *Transmit simple information*
   - *Transmit complex information*
   - *Telementoring*


CDR Carl Goforth
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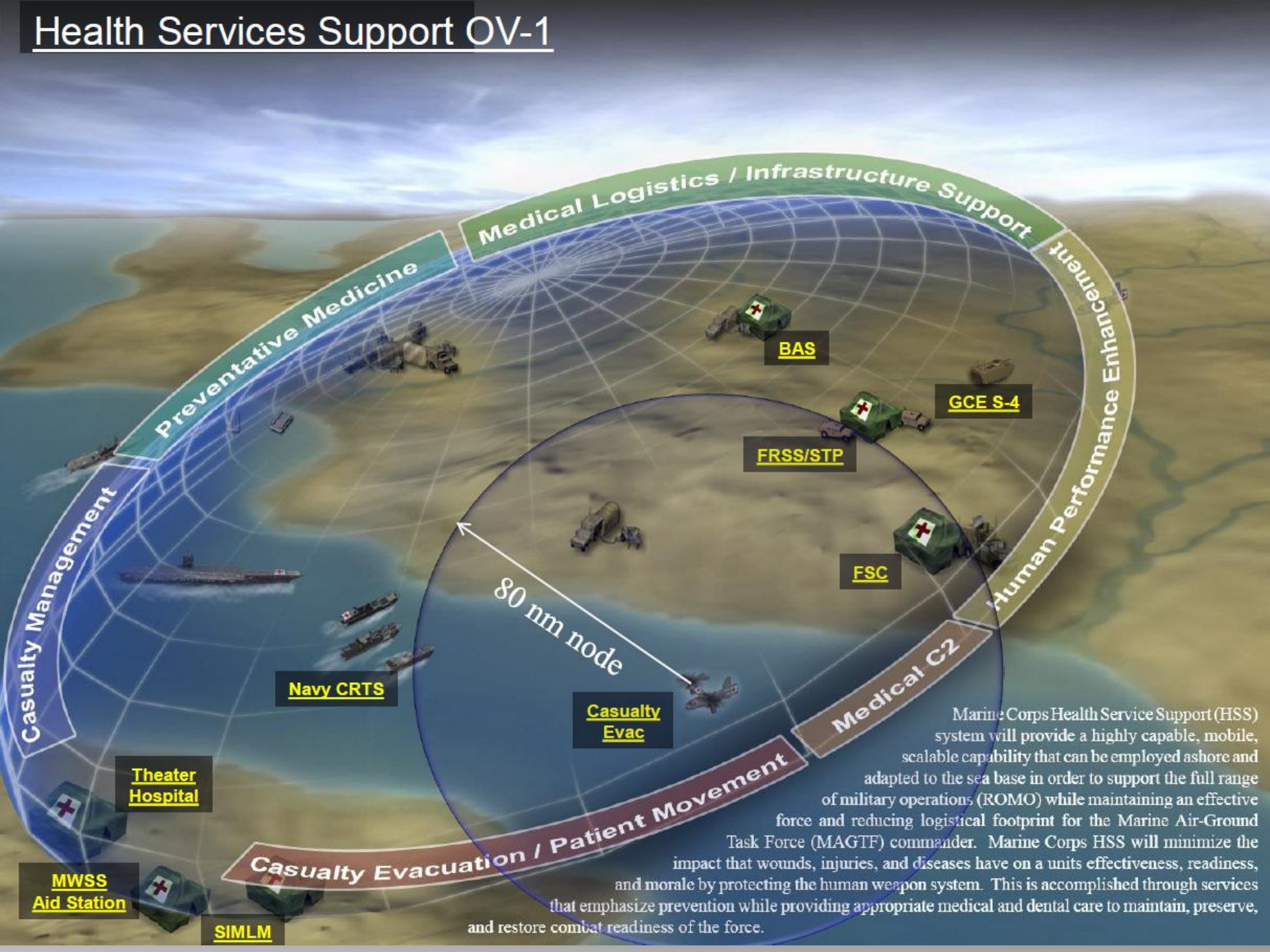
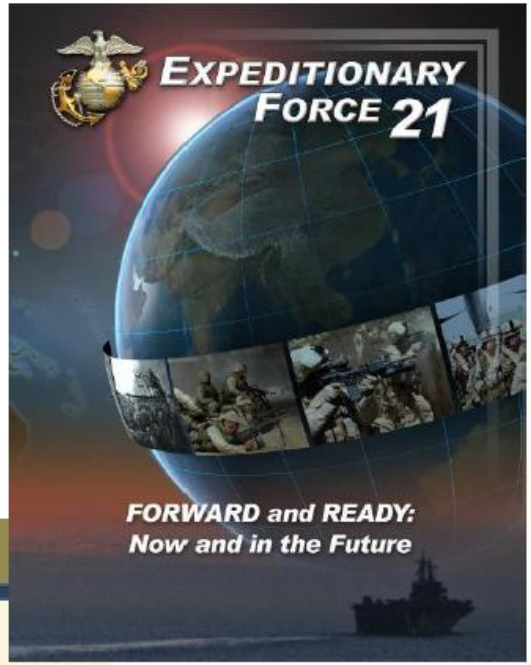
Health Services Support OV-1



Marine Corps Health Service Support (HSS) system will provide a highly capable, mobile, scalable capability that can be employed ashore and adapted to the sea base in order to support the full range of military operations (ROMO) while maintaining an effective force and reducing logistical footprint for the Marine Air-Ground Task Force (MAGTF) commander. Marine Corps HSS will minimize the impact that wounds, injuries, and diseases have on a units effectiveness, readiness, and morale by protecting the human weapon system. This is accomplished through services that emphasize prevention while providing appropriate medical and dental care to maintain, preserve, and restore combat readiness of the force.

Demand Signals

- Operational Maneuver from the Sea
- Ship to Objective Maneuver
- Seabasing and Marine Corps Operating Concepts
- Pivot to the Pacific
  - Near peer competitors
  - Anti Access / Area Denial (A2/AD)

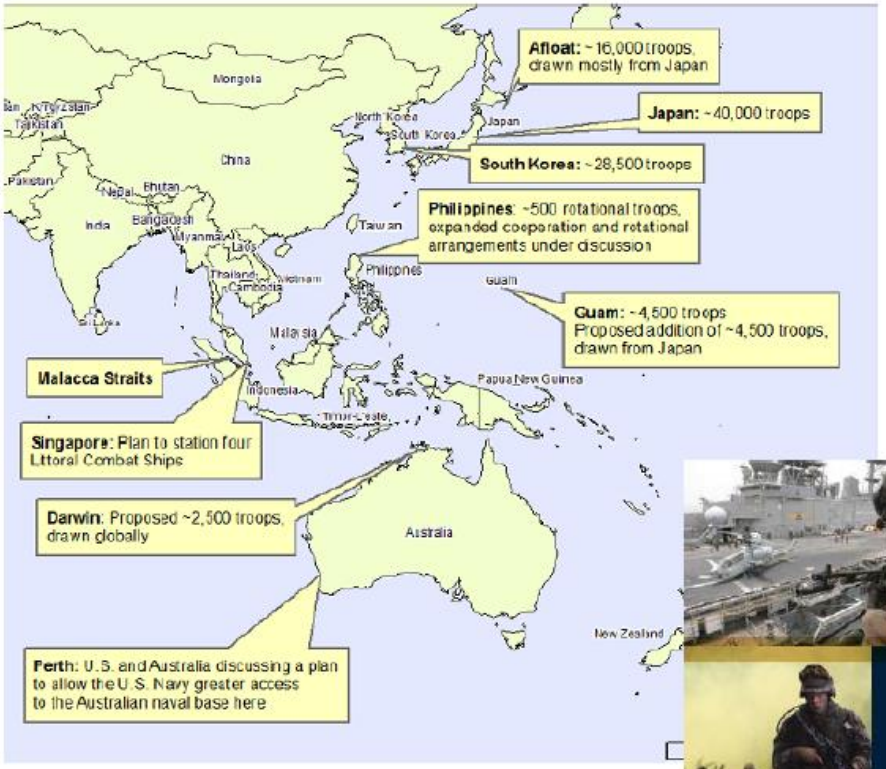


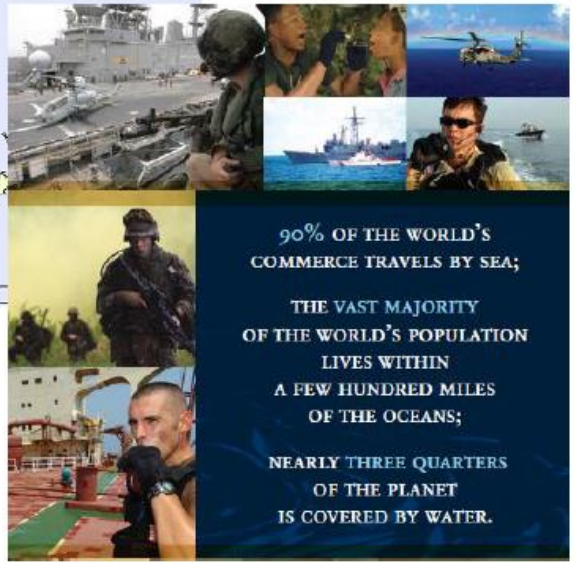
Focus: PACOM AOR

"Hollywood to Bollywood"

"Tyranny of Distance"
(as far as 165nm)

ERC focus = Long casualty holding times





MV-22 Osprey

- Joint service multi-role combat aircraft utilizing tilt rotor to leverage speed/range of a fixed wing aircraft
- Payload: 24 combat troops or 6K lbs. with a range of 430 NM (no refueling when casualties are embarked)
- Non-pressurized cabin: limited to 10,000 ft MSL when transporting patients
- Speed: 240 knots

MV-22 and Seabasing

Considerations

1. Sea base limitations
2. Clearing the sea base
3. What are the ERC implications?
4. Inflight visibility of patient status at the Seabase

MV-22 Patient Movement

Eight stanchion spots

Patient movement items (PMI) reliant on battery power

Working toward transmitting vitals signs from the aircraft over internal comms to the seabase

ERC Priorities

- USMC Operational Advisory Group (OAG) policy review group
- Casualty care in an adverse environment (noise, motion, and low light)
- Evaluating existing patient movement items for adaption to V-22 platform including potential electrical & oxygen sources
- Inflight visibility of patient status.

Current Development

Critical Care Holding & Movement

Objectives:

- Assess, via stochastic modeling, the advantages and limitations of delivering to, and clearing from, the sea-base utilizing V-22 airframes at ranges up to 165 NM.
- Identify, evaluate and test current and/or future V-22 aeromedical evacuation during sea based operations in an Anti-Access, Area Denial (A2/AD) environment.

Military Relevance:

- Characterize V-22 ability to conduct casualty care and evacuation.
- Improve patient movement and survivability across the taxonomies of care from far forward care to shipboard medical assets
- Improve the ability to conduct far forward casualty evacuation from the point of injury in an A2/AD environment

Technical Approach:

- Design, build, evaluate and test a stochastic approach to V-22 CASEVAC utilizing the Joint Medical Planners Tool (JMPT).
- Integrate
- Develop a concept of operations for V-22 medical operations in an A2/AD environment

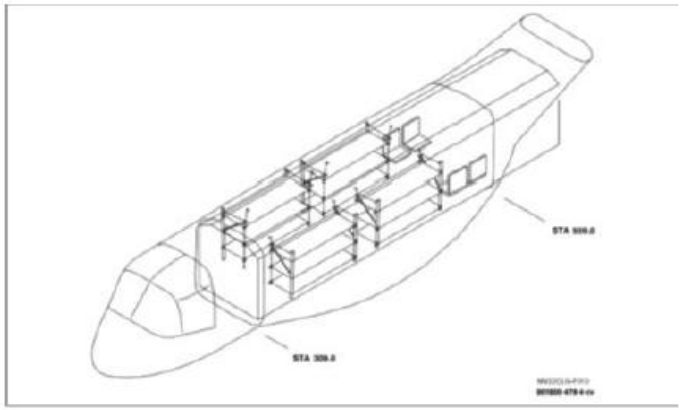


Figure 2-8. Litter Provisions (Sheet 2)

Data Needs and Questions

- Casualty Generation
  - Rates for Ashore casualties (WIA & DNBI)
    - From CREsT
  - Possible V-22 event en route with casualties (mean number of 28 WIAs) - Timing?
  - Timing of Mass Casualty Events Ashore and mean number expected
    - Day 5 with a mean number of 28

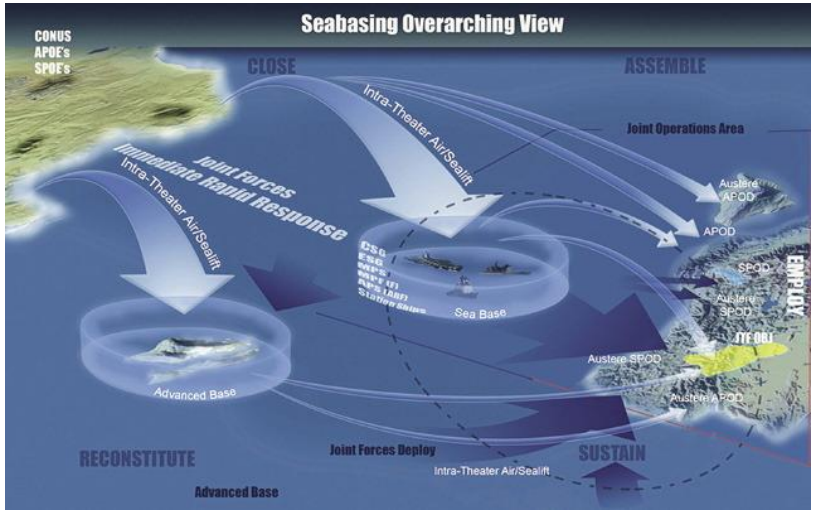
- Modified stochastic JMPT modeling to reflect capabilities of V-22

Automated Critical Care System

Dr. Tim Bentley
Office of Naval Research
FNC Force Health Protection Deputy

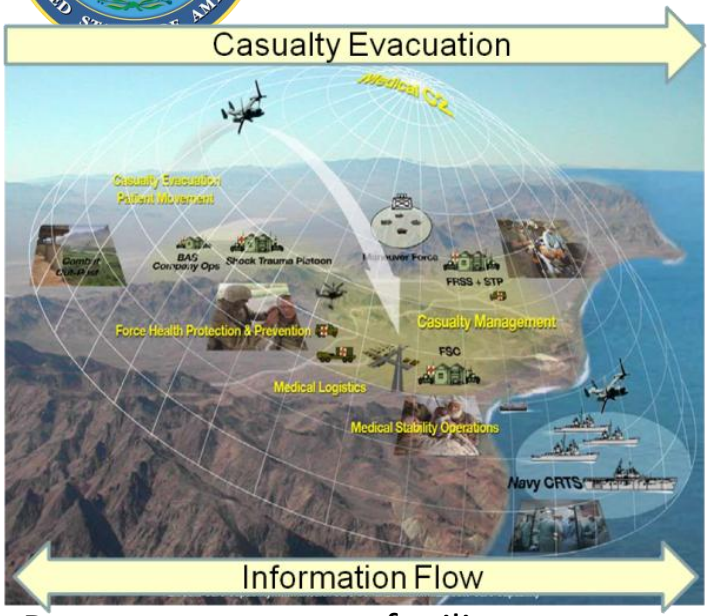
Operational Challenges

"Over the horizon force projection with operational reach approaching 240 nautical miles (nm) will … increase the risk of in-transit clinical degradation of severely wounded casualties." "The Naval Fleet and the Marine Corps lack the capability to safely transport…over the times and distances expected in Expeditionary Maneuver Warfare".
(USMC ORD for The En Route Care System)



Current C4I systems do not provide operational and clinical situational awareness to nonmedical C4I systems, and patient movement and personnel tracking systems do not interact and are labor-intensive. ***(NAVY WARFARE DEVELOPMENT COMMAND (NWDC) TACMEMO 4-02.2-14)***

The Challenge: Trauma Care on the Battlefield



"Unlike in the US and other developed countries, medical care in military operations or in disaster relief efforts involves **long times and distances** before the casualty arrives at to advanced medical care."

Due to remoteness of military operations, patient holding times may range from between 6 to 72 hours before transport to a medical center is possible

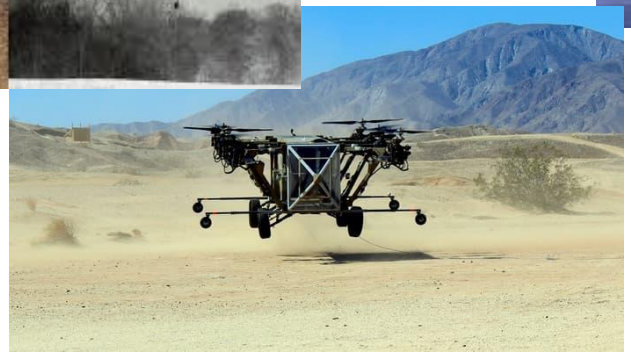
Medical Transportation Then…

Medical Transportation Now……

The Future Transport:

CASEVAC by UAV/UGV/USV

"Due to evolution of future Seabasing, ability to support Ship-to-Objective Maneuver (STOM), and establishment of Enhanced Company Operations (ECO), the Corps requires… unmanned platforms" (USMC UNS for UAS)

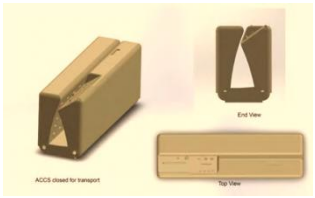


Team Retiarius UGCV

The ACCS is an essential enabler of CASEVAC by unmanned platforms

A Solution - Automated Critical Care System

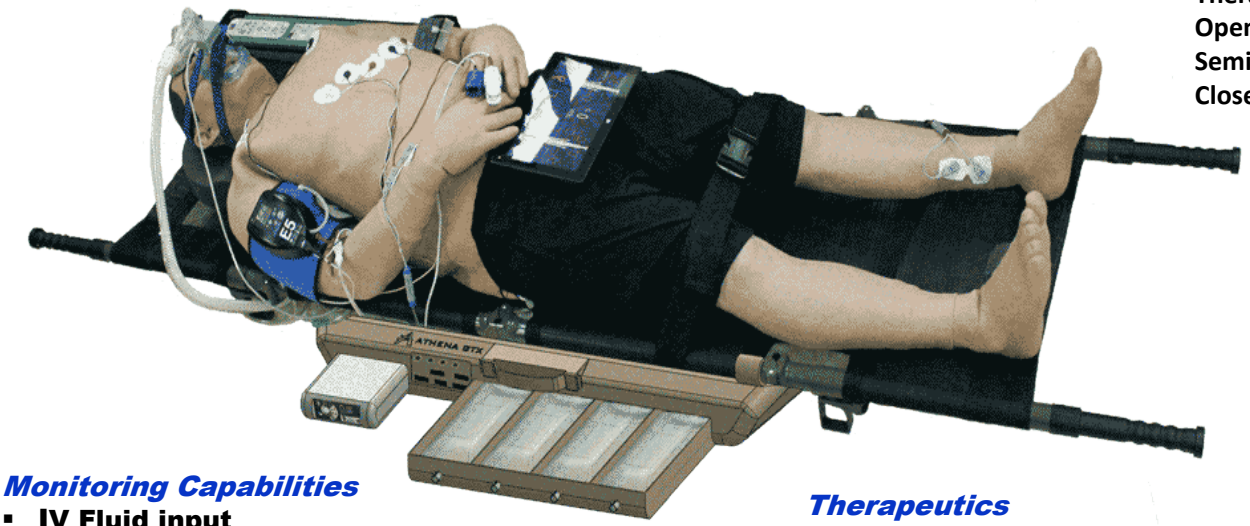
Mobile Casualty Monitoring and Care



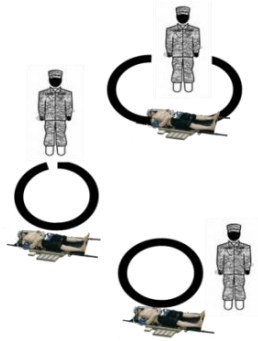
Automated Critical Care System (ACCS)

The ICU in a Suitcase

Treating multiple systems in a single patient



Therapeutic interventions:
Open loop or human in the loop
Semi-closed or human on the loop
Closed Loop or human supervising the loop



Monitoring Capabilities

- **IV Fluid input**
- **SPO2**
- **Non Invasive Blood Pressure**
- **Cardiac Output**
- **Ventilation to include Volume, Rate Pressure (PEEP)**

Therapeutics

- **Mechanical Ventilation**
- **Supplemental Oxygen**
- **Physiological Monitoring**
- **Casualty and Fluid Warming**
- **Analgesia / Sedation Therapy**
- **Fluid and Drug Infusion**

The more technologies that have to simultaneously work together increases the difficulty

Casualty Monitoring and Therapeutic Care

Closed-Loop Automated Medical Care

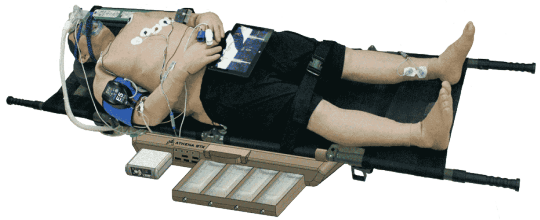
Healthcare Provider Force Multiplier

Efforts well underway:

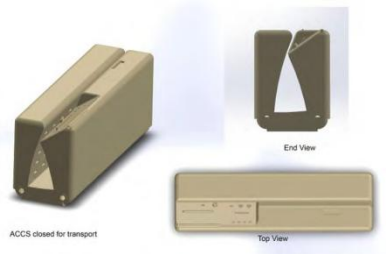
- Ability to monitor and treat multiple patients with a single ACCS.
- Integrated, redundant computers, patient data acquisition and storage.
- Low power requirements, onboard battery, accepts variety of power inputs
- Complete closed loop ventilatory support. Both integrated and external.
- Closed loop drug infusions, primarily pressors to raise blood pressure
- Multiple local communication modalities and bidirectional software interfaces for external hardware.

Additional efforts at early stages of development:

- ICU level sedation using Total Intra-Venous Administration
- Maintenance of body temperature.
- Drug administration such as antibiotics.
- Patient data transmission to receiving MTF.



Automated Casualty Care System (ACCS) at Rim of the Pacific (RIMPAC) 2016



- Our intent is to use the ACCS as an En Route Care device between the FRSS at the airfield and the sea-base.
- The focus will be on “form and fit” parameters while being moved by foot and on the V-22
- At this point, our experiment can accommodate a non-radiating ACCS (but in the future would like to go to the next step)
- Following each evolution, experiment controllers will document observations and users will be interviewed
- In the ideal, modeling and simulation mannequins will be used to inject realism to the process
- Support of a NAVAIR sponsored static display at the FRSS of a future concept of patient movement (will not be powered up/activated)

Time Frame for Deployment

Near Term Goals – FY 14-19 (+5 yrs)

- Closed Loop F_IO_2 – FDA approved, 1-2 yrs.
- Closed Loop Resuscitation – FDA approved, 2-5 yrs.
- Automated Critical Care System – Hardware-software prototype, <1 yr., followed by integrated closed loop controls, remote patient management.

Mid Term Goals – FY 20-29 (+15 yrs)

- Integrated multiple closed loop control systems – FDA approved.
- Autonomous care in autonomous vehicles.

Far Term Goals – FY 30-39 (+25 yrs)

Autonomous care of multiple patients in multi-modal vehicle over very long distances.

Strategic Aeromedical Evacuation

Lt Col Antoinette Shinn
Chief En Route Care, Combat Casualty Care Research Program
US Army Medical Research and Materiel Command
20 April 2016

Purpose

To increase understanding of USAF Aeromedical Evacuation.

- Points
  - *Aircraft*
  - *Aeromedical Evacuation Crew (AEC)*
  - *Critical Care Air Transport Team (CCATT)*
  - *Tactical Critical Care Evacuation Team (TCCET)*
  - *En Route Patient Staging System (ERPSS)*

Aircraft

C-17

KC-135

C-130

Aircraft of 0pportunity

C-21

KC-10

C-5

Aeromedical Evacuation Crew

Basic AE Crew Composition

- Two Flight Nurses
- Three Aeromedical Technicians

Configuring Aircraft

Critical Care Air Transport Team

CCATT – Specialty Team

3 Members

- Physician/Intensivist
- Critical Care Nurse
- Cardiopulmonary Craftsman

Tactical Critical Care Evacuation Team

TCCET - 3 Person Team

- ED Physician
- ED Registered Nurse
- Certified Registered Nurse Anesthetist

Tactical Critical Care Evacuation Team - E

TCCET – Enhanced (TCCET-E)

3-Person TCCET Team Plus:

- Surgeon
- Surgical Technician

En Route Patient Staging System

- Modular System - Right Size footprint
- Provides support &continuity of care for patient movement
- An integral patient interface to En Route Care Capability
- Personnel & equipment for 24-hour patient staging operations
- Patient transportation to/from aircraft
- Administrative tracking patients transiting the ERCC

Developing En Route Care Medical Devices

Lt Col Jennifer Hatzfeld, PhD, RN
En Route Care Portfolio Manager
Combat Casualty Care Research Program
Fort Detrick, Maryland

Overview

- **Clinical Validity**
  Does it make a difference in patient care?

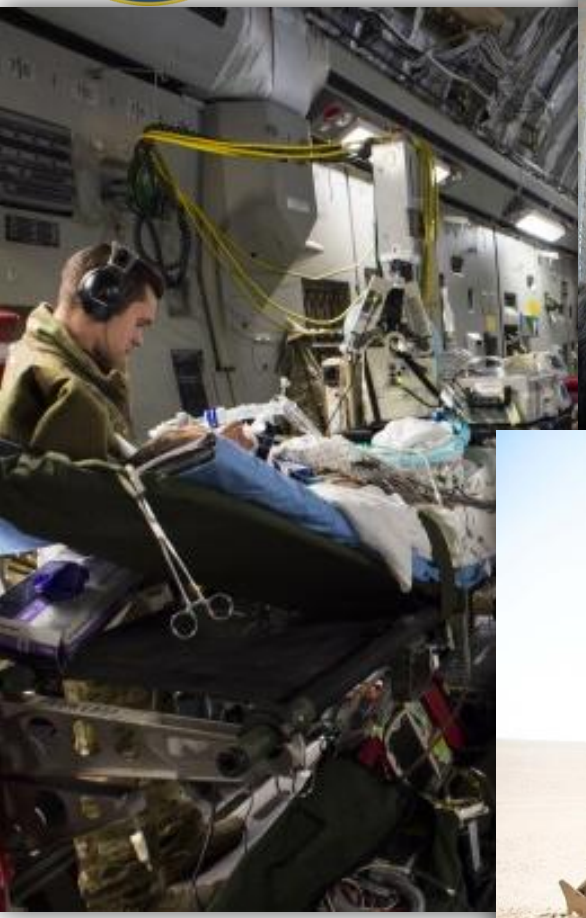
- **Airworthiness**
  Does the equipment function in the transport environment?

- **Clinical Validity in Transport**
  Does it actually work in patients in the transport environment?

Clinical Validity

- Main point: care provided during transport is same as the sending medical facility
  (no decrement to level of care)
- FDA approval
  - Requirement for all equipment used in combat casualty care
  - Indication for use in transport environment is helpful but not required
- Evidence that improves patient outcomes

Transport Platforms Can Vary!



Joint Enroute Care Equipment Test Standard

- Rotary-wing vibration (1 profile)
- Fixed-wing vibration (2 profiles)
- EMI emission (3 methods)
- EMI susceptibility (5 methods)
- Hot temp (operational & mission-ready storage): 49, 54, 60 °C
- Cold temp (operational & mission-ready storage): 0, -13, -26 °C
- Humidity: 41-44 °C, 88-95% RH
- Altitude: up to 18,000 ft
- Rapid decompression
- NVG evaluation
- Explosive atmosphere
- Acceleration & securing procedures (> 5lb)
- Battery test (at extreme temperatures)
- Electrical safety (before and after all testing)
- Laboratory human factors
- Aircraft EMC chamber test
- Ground, hover, altitude EMC Tests (RW Aircraft as victim)
- In-flight RW EMC evaluation (medical device as victim)
- In-flight medical and human factors assessment (RW & FW)
- Ground vibration
- Blowing sand
- Blowing dust
- Blowing rain

Key Points about Airworthiness

- Test plan will depend on the aircraft and equipment
- Most tests are not pass/fail
  gives information to make a risk analysis
- Airworthiness determination is made for EACH aircraft
  (HH-60, CH-47, V-22, C-17, C-130, etc.)
- Waivers can be granted, but must be made for <u>each mission</u>
  & need technical data to make the determination

Stresses of Transport

Stresses of Flight (<10,000 ft)

- Decreased PaO2
- Decreased barometric pressure
- Decreased humidity
- Noise*
- Vibration*
- Temperature changes*
- Gravitational forces*
- Fatigue*

(from AFI 41-307)

Other Considerations

- Confined space/secured *(lack of movement)*
- Lighting *(night vision goggles/red lights)*
- Turbulence *(safety of crew/clinicians)*
- Open windows *(dust/wind/rain)*
- Psychological stress *(difficult to concentrate)*
- Unpressurized cabins (ex. V-22)

*could apply to all transport

Take-Away Points

- Primary concerns about medical devices:
  - Device does not negatively impact the mission or the transport platform
  - Provide adequate medical care during transport
  - Airworthiness does not mean the device performs the same as it does on the ground
- The Joint En Route Care environment is dynamic and challenging
- Space/Weight is limited; only the Army has a *dedicated* aeromedical transport platform
- Devices (and procedures) need to be seamless throughout the continuum of care

Questions?

For additional questions after the conclusion of the conference, send an email message to usarmy.detrick.medcom-usamrmc.mbx.mmpd@mail.mil