Telemedicine to Reduce Medical Risk in Austere Environments

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Deputy Director

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Purpose: To review how telemedicine can support caregivers performing austere medicine and the current military telemedicine solutions available

Outline:

1. To understand that telemedicine is NOT plan A, but is a solution that can support plan B
2. To understand how telemedicine can augment care from POI through evacuation to R4
3. To understand limitations of current technologies
4. To learn how to apply current telemedicine capabilities in the austere, operational environment
TAMAR RESCUE

103rd Rescue Squadron

https://youtu.be/JCRPF4UymyY
**CL Garoua MEDEVAC 14 MAY 2017**

**OVERVIEW**

**PATIENT:** XX1234  
**POSITION:** TF Toccoa MD  
**INJURY:** Possible Narrow Complex Tacacardia (Irregular heart rate / pulmonary symptoms)  
**NOTIFICATION:**  
- USARAF COIC (PA/SURGEON)  
- USEMBs in Chad and Cameroon  
- SOCC / SOCAF  
- AFRICOM  
- 1/101st ABN  

**EVENT SUMMARY:** On Monday 14 May 2017 XX1234, the TF Doctor, experienced intermittent tachycardia starting at approximately 0630Z. At 1000Z this happened again and XX1234 advised TF Medics to hook him up to the five lead EKG for monitoring. Contact with CPT Auchincloss, USARAF PA, was made at 1100Z for medical consultation and recommendation made to evacuate casualty. XX1234 had two more episodes in the following two hours, with heart rate spiking from 80bpm to 150bpm while at rest. The TF coordinated with USARAF and SOCC in order to facilitate MEDEVAC, beginning at 1200Z. A SOCAF MEDEVAC aircraft arrived at CL Garoua at approximately 1530ZXX1234 was then flown to the French ROLE II facility in N'Djamena, arriving at .

**PATIENT TREATMENT:** XX1234 was monitored by EKG and given two ice packs to place on his head and chest at 1110Z. A saline lock was initiated in the patients left AC and TF Medics continued monitoring the patient. The AED and Adenosine injection 6mg/2ml was on hand for treatment following possible LOC or cardiac arrest, however, the only person with experience administering Adenosine for this condition was the patient himself.

**CURRENT PATIENT STATUS:** XX1234 is currently at the ROLE II in N’Djamena, Chad being monitored by the medical team there. He has had no episodes since leaving CL Garoua. The TPMRC-E is working with Camp Kossei ROLE II to move XX1234 to LRMC in Germany for further medical evaluation and treatment. (UPDATE – Patient has been moved to Role IV in Germany)

**CL GAROUA MEDEVAC TO NDJAMENA**

**OIC/NCOIC**

- MAJ Ferguson – TF CDR  
- daniel.m.ferguson4.mil  
- DSN: 94-408-647-5020
- SSG Kirkwood – Aid Station  
- ryan.s.kirkwood.mil  
- DSN: 408-647-5072

**SUPPORT ASSETS**

- SOCAF MEDEVAC Twin Otter DH6  
- French ROLE II Facility  
- In-Flight Care by SOCC Medical Team

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**TIMELINE**

<table>
<thead>
<tr>
<th>DTG</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100Z</td>
<td>INITIAL EVALUATION</td>
</tr>
<tr>
<td>1120Z</td>
<td>STAND-BY NOTIFICATION</td>
</tr>
<tr>
<td>1200Z</td>
<td>MEDEVAC NOTIFICATION</td>
</tr>
<tr>
<td>1400Z</td>
<td>A/C: ENROUTE CL GAROUA</td>
</tr>
<tr>
<td>1530Z</td>
<td>A/C: ARRIVAL CLGAROUA</td>
</tr>
<tr>
<td>1553Z</td>
<td>A/C: DEPARTS CL GAROUA</td>
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<tr>
<td>1710Z</td>
<td>A/C: ARRIVAL N’DJAMENA</td>
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</tbody>
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**Lessons Learned**

1. **Improve:** TELEMED system needs on hand network of SMEs and providers to assist outstations with medical emergencies

2. **Improve:** CL Garoua lacked adequate EKG to effectively monitor and evaluate cardiac condition.

3. **Sustain:** Previous MEDEVAC rehearsals significantly improved evacuation process with USARAF COIC and SOCAF.
• Did not use current telemedicine products to support them

• Instead, used ad hoc telemedicine for success
  – Call to Team Flight Surgeon
  – Call to BAMC Burn Center
Definitions

- **Telemedicine** is remote evaluation, diagnosis, treatment, and/or consultation using telecommunications technologies.

- **Asynchronous communication** is one-way (unidirectional, time delayed) communication.
  - For example, a text or an e-mail message.

- **Synchronous communication** is two-way (bi-directional, real-time) communication.
  - For example, a phone call or VideoTeleConference (VTC).

- **Extended consultation** is a combination of asynchronous and synchronous consultation that maintains clinical engagement with the care of a patient(s) over time by monitoring physiologic vital signs, audio channel(s), video feed(s), or combinations of these technologies.

- **A Local Caregiver** is the person who is taking care of a patient and who initiates teleconsultation.

- **A Remote Consultant** is the clinician who receives the consult from the local caregiver.

- **A Remote Provider** is a *provider* who provides direct patient care from a distance (e.g. telebehavioral health).
Key questions:
• Why haven't we needed this before?

Answer:
• We have!
• Traditionally teleconsultation is handled tactically by consulting with in-theater assets
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- Why haven't we needed this before?

Answer:

- We have!
- Traditionally teleconsultation is handled tactically by consulting with in-theater assets
The Tyranny of Distance and Air/Area Denial

OIF/OEF (2009-2014)

1 hr POI
MEDEVAC MERT
Role IIb or Role III
STRATEVAC
LRMC
STRATEVAC

Time without Critical Care < 1 hr

Austere Med (Current)

1-3 Days
Pre-Evacuation Care
CASEVAC (+/- MIL)
FWD Hospital Care
Medic advocate
STRATEVAC
LRMC

Time without Critical Care 1-3 Days

Key

providers with no critical care training
some critical care training
critical care trained providers
“As Army looks to move into Multi-Domain Battlefields, engage in congested cities, and enhance utilization of remote small teams MEDCOM’s need to virtualize care in the Army must increase.”

– COL Daniel Kral
TATRC Director (2013-2018)
“Win in a complex world”

Medical Challenge: “Optimize combat casualty care in a complex war.”

Army Operating Concept, 2020-2040 TRADOC. October 2014

Mega Cities globally (> 10 MIL people)
- 1990: 10
- 2014: 28
- 2030: 41

66% of populations living in urban areas by 2050
Austere Medicine

- A situation defined by limited resources of some or all of the following:
  - Equipment
  - Medicine(s)
  - Diagnostics
  - Personnel
  - Knowledge, training, skills, and/or expertise

*Prolonged field Care*
“Treating a patient that you know should be somewhere else, for longer than you want.”

– MAJ Doug Powell, MD
USASOC Intensivist
Medical Problems Differ in PFC

Empiric Probability Combat Death

- CNS Trauma
- Hemorrhage
- Sepsis

Decision Making
- Evaluate
- Diagnose
- Treat
- Discuss
- “Manage”
- Synchronize Care
Telemedicine bridges the gap by providing critical care support to the non-surgically supported ground guy using telecommunications technology.

- Telemedicine is NOT plan A!
- Plan A is training and deployment of necessary medical support.
- But, when these fail, what next (plan B)?
Potential Advantages

• Delivery of the expert to the point of need
  – Smaller *physical* footprint of medical personnel
  – Equal or improved access to care providers
  – Less casualty/patient movement (i.e. MEDEVAC for evaluation)
Mission: To provide a spectrum of on demand consultation services in operational settings
<table>
<thead>
<tr>
<th>Emergent</th>
<th>Urgent</th>
<th>Routine</th>
<th>Direct Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consult within <strong>minutes</strong>&lt;br&gt;Life threatening or potentially life threatening conditions like:&lt;br&gt;  - Shock&lt;br&gt;  - Respiratory failure&lt;br&gt;  - Renal failure&lt;br&gt;  - Liver failure&lt;br&gt;  - Complex wounds&lt;br&gt;  - Polytrauma&lt;br&gt;  - Burns&lt;br&gt;  - Severe infection/sepsis&lt;br&gt;  - Crush injuries&lt;br&gt;  - Severe electrolyte abnormalities&lt;br&gt;  - Encephalopathy/severe TBI&lt;br&gt;  - Abnormal vital signs&lt;br&gt;  - Complex arrhythmias.&lt;br&gt;  - Poisonings&lt;br&gt;</td>
<td>Consult within <strong>minutes</strong>&lt;br&gt;Urgent consults are all other cases that do not fall under the routine or emergent categories.&lt;br&gt;Urgent consults usually require specialty medical advice (i.e. general surgery, orthopedic surgery, infectious disease, toxicology, pediatrics, behavioral health, burn care, etc.) and would benefit for synchronous communication between the local caregiver and the remote consultant.&lt;br&gt;</td>
<td>Response within <strong>24 hours</strong>.&lt;br&gt;NORMAL vital signs&lt;br&gt;Not going to deteriorate in 24hrs&lt;br&gt;</td>
<td>It must always be planned ahead of time&lt;br&gt;Direct patient care is NOT teleconsultation.&lt;br&gt;DC uses VTC to evaluate and treat patients who are in a different location.</td>
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WHO

<table>
<thead>
<tr>
<th>Who</th>
<th>How</th>
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<tbody>
<tr>
<td>Primary</td>
<td>Normal every day business</td>
</tr>
<tr>
<td></td>
<td>- TSOC, RSM, COC, etc.</td>
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<tr>
<td></td>
<td>Phone, E-mail</td>
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<tr>
<td>Alternate</td>
<td>ADVISOR</td>
</tr>
<tr>
<td></td>
<td>Routine, Urgent, Emergent</td>
</tr>
<tr>
<td></td>
<td>Email/Portal, “Cart”, Phone</td>
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<tr>
<td>Contingency</td>
<td>Phone a “friend”</td>
</tr>
<tr>
<td></td>
<td>Phone, e-mail</td>
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<tr>
<td>Emergency</td>
<td>Local non-standard</td>
</tr>
<tr>
<td></td>
<td>Movement, Phone, Smoke</td>
</tr>
<tr>
<td></td>
<td>Signals</td>
</tr>
</tbody>
</table>

“ADVISOR is a *lifeline* for the operational caregiver who has no other good option to get help.” – Unnamed Medic
• Deployed caregivers make calls to get help everyday
  – Usually to local resources: battalion/brigade surgeon, RMSO, CSH/FST, etc.
  – Sometimes these assets don’t have a good answer/the right specialist
    • 4 real calls from R3 to ADVISOR (1 critical care, 3 infectious disease)
  – Often caregivers “phone a friend”
    • Ad hoc solution that cannot be tracked or improved
    • Does not exist for every caregiver (requires previous relationships)
• **VC3 from R3**: Recommendations regarding management of severe ARDS in local national

• **ID from R3**: Recommendation for resistant Acinetobacter infection treatment, local national

• **VC3/GS/Peds from SOCAF**: Stab wound to abdomen of child of partner force, recommendation for surgery
  – McLeroy et al. JSOM 2016;16(4)110

• **ID from CENTCOM (OB in AFG)**: Febrile illness with organ dysfunction (liver). Recommendations regarding evacuation and treatment. **Synchronous consult supported by asynchronous communication avoided evacuation**

• **VC3 from SOCAF**: Management of potential CBRN exposure, **Synchronous consult supported by asynchronous communication allowed delayed evacuation and mission completion**
  – Lee et al. JSOM 2018 (in press)
Operational Telemedicine
Estimated Demand

0.99% Synchronous Procedural Mentoring (video assisted)
4% Synchronous Crit Care Monitoring (vital signs)
10% Synchronous Critical Care Consult (Telephone)
15% Synchronous: Teleconsult (Telephone, VTC)
0.01% Continuous Synchronous Surgical Support

70% Asynchronous
E-mail
Text
Image send

**Created from review of 2 years of AKO e-mail consultation data**

Nettesheim, et. al. Military Medicine, (2018)
https://doi.org/10.1093/milmed/usy127
Operational Telemedicine
Estimated Demand in MASCAL
Large Casualty Scenario(s)

FIGURE 3. Estimated demand for operational telemedicine. The bulk of telemedicine requests are routine and require only asynchronous communication.
• We will have reliable, large bandwidth, low latency, fully functioning tele-communications network during our next “war”
  – Reality: we don’t currently and communications will always be vulnerable
Teleconsultation Support Technologies

- Asynchronous (3-4 kbps)
- VS Wave Forms (10 kbps)
- Voice (10-100 kbps)
- Video (10-250 kbps)
- Quality Video (500-1000 kbps)
- High Definition Procedural Video (1000-2000 kbps)

Latency:
- Almost None
- Long

Bandwidth:
- Low
- High

Casualties:
- Single
- Multiple

Capability:
- Routine Consult
- Situational Awareness
- Continuous remote monitoring
- Immediate or Urgent Consult
- Optimal Critical Care Consult
- Procedural or Surgical Support
Technology and Medicine

- Automation/Robotics
- CDSS
- Clinicians

Relative strengths of computer vs. human information processing

Uncertainty

Telemedicine fills the Gap

Knowledge

Expertise

Wisdom

INTEROPERABILITY!

Intelligent Systems. 2014
“Robotic and semi-autonomous patient support systems integrated with general purpose unmanned vehicle platforms could serve as significant force multipliers in support of prolonged field care and patient evacuation when dedicated medical assets are denied entry or otherwise unavailable.”

– Gary Gilbert, PH
Capability Area Manager

“Remotely supervised by TCC workstations.”

– Dr. Jeremy Pamplin
How to get there from here?

Management is HARD
- Complex systems
- Unclear, variable rules
- Unclear, variable processes
- Time changes inputs
  - Point of injury
  - Evacuation Platforms

Human Evacuation and Management of Combat Casualties

Autonomous Evacuation of Combat Casualties

Fully Autonomous Evacuation and Management of Combat Casualties

HITL or Remote Supervision of Semi-Autonomous Management of Combat Casualties

CDSS &/or Telementored Management of Combat Casualties

Currently possible Requires Healthcare Provider support

Currently in-development Offers platforms to acquire data

Requires data
Animal & Human Testing
*Few autonomous systems currently available

Currently possible
Requires data
Animal & Human Testing
*Few autonomous systems currently available
• It’s not about the tech… it’s about the people!
  – Technology makes what we do more efficient or reliable

• Telemedical technology solutions for operational forces must be:
  – **Flexible**: capability adapts to the network resources available and can be used in many care scenario
  – **Scalable**: useable for one or many patients
  – **Convenient**: no new kit, user friendly
  – **Reliable**: works every time
  – **Consistent**: same tech on each mission
Practical Points
• **Telemedicine is Facetime or Skype (i.e. requires VTC)**  
  » Reality: it is also an e-mail, a text, a phone call

• If I use telemedicine, it means I don’t know what I’m doing  
  » Reality: EVERY medical provider asks for consults (i.e. asks for help); nobody knows everything

• **Telemedicine is easy**  
  » Reality: good telemedicine (i.e. efficient, reliable, consistent) takes practice and is a SKILL

• If I provide teleconsultation and the patient doesn’t do well, I am LIABLE  
  » Reality: remote experts can only provide the best consultation they can with the information provided and the care provided is limited by the resources available. DOCUMENT.
Summary of Recommendations:

• **PLANNING**: Providers should develop a teleconsultation PACE (Primary, Alternate, Contingency, Emergency) plan before deploying.

• **TRAINING**: Local caregivers and remote consultants must train to provide optimal care using various telemedicine technologies: phone, VTC, remote ultrasound guidance, etc. This should consist of classroom training and practical exercises.

• **TECHNOLOGY**: Technology is a tool, not a requirement: use the best technology available, but do not waste time or resources making technology work if a “lesser” or more efficient tool is sufficient.

• **SECURITY**: Do not delay teleconsultation due to an unsecure connection unless operational situations dictate otherwise.
PREPARE:
- Optimal teleconsultation occurs when caregivers are prepared.
- Develop a PACE plan to utilize and refine during training events.
- Document patient care using flow sheets and call scripts familiar to both the local caregiver and remote consultants.

RECOGNIZE:
- Caregivers should call when they have a question. Optimal treatment requires caregivers to recognize their limitations.

EXECUTE:
- Send available patient information by email or text approximately 10-15 minutes ahead of the call when possible.
- Make the call using a script.

PERFORM: PROBLEM SOLVE!
- Understand capabilities and limitations of the technology available. Intentionally train with full and degraded communications.
• Proctoring medical scenarios
  – Tendency to *give answers* for training vice solving problems
  – Remote consultants NEED realistic scenario development
    • Option 1 – telemedicine consultant is a confederate
    • Option 2 – scenario changes depending on telemedicine understanding of presentation
  – Engaging telemedicine team may enhance scenario realism and/or improve training.
  – USE A SCRIPT
Questions?

Cool Video😊

LTC Jeremy Pamplin, jeremy.c.pamplin.mil@mail.mil

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Hurry,

CE Certificates will only be available for 30 DAYS after this event!
Network Limitations

- **Latency**: distance/time to travel (length of pipe)
- **Bandwidth**: amount of information that can move at once (size of pipe)
- **Jitter**: Variable delays in packet arrival
- **Error**: packet corruption
Future Directions
Challenges to Manage Patients in Isolation Environments: Data access, Intravenous Fluid management, Ventilation

- **Ventilator**
- **IV Pumps**
- **Resuscitation**
- **Sedation**
- **Analgesia**
- **Renal Replacement**
- **Extracorporeal Life Support**
- **Minor Procedures**
- ... Surgery?

**Ventilator adjustments** are performed by Respiratory Therapists or other trained staff. 20-minutes don/doff time would occupy all staff time.

**Intravenous Fluid** Example:
IV fluid flow = 100 ml/min
Begin new medication outside of room: 20 Minute delay for the new medication dose to reach the patient.

IV flow analysis Courtesy of R. Peterfreund, MD PhD, MGH