SYNCHRONOUS TELEMEDICINE SPECIALTY SUPPORT TO SOF

LTC Shawn Alderman, MD
5th SFG(A) • BACH • DDEAMC

BACKGROUND

- Environment
- Asset Gaps
- VC3
- BACH / DDEAMC
REQUIREMENTS

• **Process**
  - Simple
  - Responsive Staffing

• **Technology**
  - Web Based
  - Two-way Video

• **Redundancy**
  - Synchronous
  - Asynchronous

PROCESS

• **Specialty Coverage**
  - Ortho
  - Gen Surg
  - Critical Care

• **Single Phone #**

• **Script Sheets**

• **PII and OPSEC**
TECHNOLOGY

• Acano
• Global Med
• Cameras
• Connectivity
• Tablets
LESSONS LEARNED

• Technology
  - SDN vs SNAP
  - Network Authorizations
  - Technical Support

• Process
  - No issues
  - Excellent Specialist/MTF Support

• Simple and Redundant
Telemedicine to Reduce Medical Risk in Austere Environments

LTC Jeremy C. Pamplin, MD, FCCM, FACP
Director, Virtual Critical Care
Madigan Army Medical Center
Joint Base Lewis-McChord

• 24 May 2016

DISCLAIMER

The views expressed are those of the author(s) and do not reflect the official policy or position of the US Army Medical Department, Department of the Army, Department of Defense or the U.S. Government.

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Overview

• Background and rationale for virtual medical support to operational forces

• Definitions

• Current Experience

• Future Directions

The Tyranny of Distance and the Paradox of Time

OIF/OEF (2009-2014)

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

Time without Critical Care < 1 hr

Key

- providers with no critical care training
- some critical care training
- critical care trained providers

Austere Med (Current)

POI Pre-Evacuation Care CASEVAC (+/- MIL) FWD Hospital Care

Medic advocate STATEVAC LRMC

Time without Critical Care 1-3 Days
DEFINITION

- **Prolonged Field Care (SOMA WG)**
  - Field medical care, applied beyond ‘doctrinal planning timelines, by a **Special Operations Combat Medic or higher**, in order to decrease patient mortality and morbidity. Utilizes limited resources, and is sustained until the patient arrives at an appropriate level of care.

> “Treating a patient that you know should be somewhere else, for longer than you want.”
> - MAJ Doug Powell, MD
> USASOC Intensivist

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**Medical Problems Differ in PFC**

![Empiric Probability Combat Death](image)
Telemedicine

• Medical support must adapt to the complex, distributed, and dynamic missions at hand
Telemedicine

- Medical support must adapt to the complex, distributed, and dynamic missions at hand

- Telemedicine is NOT plan A

- Plan B?

- Not a panacea: Technology is not “Murphy-proof”
  - Training and back-up systems (i.e. CDSS, protocols, TTPs, etc.) are necessary

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Man versus Machine or Man + Machine?

Mary (Misoy) Cummings, Duke University and MIT

[Diagram of man versus machine]
Definitions

• Local Caregiver

• Consultant/Remote Expert

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

**Communication, Consultation, and Mentoring: Local Caregiver & Remote Expert**

- = asynchronous communication - unidirectional information flow (i.e. text, e-mail)
- = rapid asynchronous communication
- = synchronous communication – bidirectional information flow (i.e. voice, video, both)

Patient Care Encounter by Local Provider

- Continuous Remote Monitoring
  (extended unidirectional communication)
  &
- Continuous remote supervision
  (extended synchronous communication)
Mission: To provide *immediate* consultation for critically ill/injured patients to clinicians supporting prolonged field care.

**Virtual Critical Care Consultation**

**The VC3 Service**

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**Project Start**

- Reviewed all consultations placed to the Teleconsultation Program for FY14 and FY 15 for the potential of clinical deterioration or death that might benefit from critical care consultation.

- Results:
  - 321 consultations
  - 14.6% (47/321) with potential for clinical deterioration and death.
  - Most common subspecialties included
    - neurologic/neurosurgical emergencies, 23% (11),
    - Burns, 21% (10),
    - Toxicology, 19% (9),
    - general surgery 15% (7).
  - Other diagnoses with critical care implications were 21% of consults
    - severe allergic reactions, 6% (3)
    - thyroiditis/Graves disease, 11% (5)
    - pulmonary issues, 4% (2)
  - Average reply time: 4 hours 34 minutes
  - Median reply time: 1 hour 6 minutes.
Conclusion

- A potential need exists for more urgent/immediate consultation about critically ill patients in operational environments.
VC3 AAMTI Purpose

- To develop a low cost, effective VC3 capability for MTFs without critical care specialists and providers engaged in PFC
  - Demonstrate viability
  - Create/refine SOPs, TTPs, and CPGs to support capability
  - Integrate into treatment protocols of customers
  - Explore technology to augment the capability (i.e. cellphone, COTS VTC, monitors like Tempus Pro)
  - Collect data on the nature of consultation and type of information collected from the end user
  - Provide a model for extension to other specialties and expansion to a wider customer base

Figure 1. Special Operations Medical Sergeant caring for a simulated critically ill trauma patient during the Mountain Path prolonged field care training exercise. Using the Virtual Critical Care Consultation (VC3) call guide, the medic, if able, first sends images of the casualty, care documentation flow sheets, and available equipment via e-mail to the VC3 distribution list and then calls the VC3 phone number which forwards to the on call VC3 intensivist who provides consultation.
Experience

- > 30 Training Exercises, > 70 “casualties”
  - Averaged 3.6 calls per exercise

- 6 critical care specialists served as consultants
  - An average of 3.3 recommendations made per call.
  - Case Mix: Burns, Sepsis, TBI, Poly-Trauma, internal hemorrhage
  - All consultants rated the quality of consultations as appropriate

- 8/60 participants (13% response rate) to survey
  - “No difficulties” in reaching a critical care provider.
  - Consultant Recommendations
    - improved the management plan
    - were appropriate for their level of training
    - were not difficult to implement after ending the call

VC3 Progress

Telemedicine to Reduce Medical Risk in Austere Medical Environments

The Virtual Critical Care Consultation (VC3) Service

Doug Powell, MD; Robert D. McLenor, MD; Jamie Riesberg, MD; William Vasios, MPAS;
Ethan Miles, MD; Jeffrey DellaVolpe, MD; Sean Keenan, MD; Jeremy Pamplin, MD


6 real cases over ~12 months

Case of a 5-Year-Old Foreign National Who Sustained Penetrating Abdominal Trauma

Robert D. McLenor, MD; John L. Ellis, DO; Jason M. Kainopp, NREMT-P, ATP;
Jeffrey DellaVolpe, MD; Jennifer Gurney, MD; Sean Keenan, MD; Doug Powell, MD;
Jamie Riesberg, MD; Mary Edwards, MD; Renee Matos, MD, MPH; Jeremy Pamplin, MD

Embedded Fragment Removal and Wound Debridement in a Non-US Partner Force Soldier

Robert D. McLenor, MD; Sloan Spielman; Eric Jacobson, MD; Jennifer Gurney, MD;
Sean Keenan, MD; Doug Powell, MD; Jamie Riesberg, MD; Jeremy Pamplin, MD
Lessons Learned/Key components

• Fundamentals (RP3):
  1. Recognize the need to call (local caregiver)
     • Clinical question
  2. Prepare to call
     • Flow sheets, scripts, images
     • Send ahead!
  3. Present patient(s)
     • Use script…. On BOTH sides of the call!
  4. Perform with telementoring
     • Know your technology (e-mail, cell phone/land line/SATCOM, VTC)
     • Perform Procedure with Telementoring

• Its not about the tech... its about the people!
  • Technology makes what we do more efficient or reliable by helping solve problems
  • Training is imperative.... On both sides!

Key components

• Its not about the tech... its 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
Gaps/Challenges

• Currently **three systems** provide consultation to deployed SOF providers:
  - Army’s TSG E-mail consultation service
  - The Synchronous Telemedicine Specialty Support to Special Operations Forces (STS₃)
  - Virtual Critical Care Consultation (VC₃) Service

• Request made by USASOC surgeon to “provide rules” about which service to engage and when...

Mission

To provide a spectrum of *on demand* medical consultation services in operational settings
Consult types

- **Routine**
  - Use the e-mail teleconsultation system
  - Consultation within 24 hours (median response ~ 4 hours).

- **Urgent** (phone calls answered immediately 24/7)
  - *Non-critical care sub-specialty consultation*, call STS3

- **Emergent** (phone calls answered immediately 24/7)
  - *Consultation for patients with critical illness or injury* call VC3

### ADVISSOR Workflow

See appendix A of the ADVISSOR SOP
You have reached the Special Operations Virtual Critical Care Consultation Service, please press any number to be connected to the critical care physician on call.

Call 1st call on call roster

Call 2nd call on call roster

We are unable to access the critical care physician on call, your call is being directed to the Army Burn Center’s Burn ICU Nursing Station. When the call is answered, please state that you need to speak with a VC3 or CRITICAL CARE PHYSICIAN, not a BURN SURGEON, this will help them connect you to the correct consultant.

Call 210-916-2876

Commercial XXX-XXX-ST33 (7873)
You have reached the Synchronous Telemedicine Specialty Support to Special Operations Forces, please listen to the following menu options:
Press 1 to connect to the general/truma surgeon on call
Press 2 to connect to the orthopedic surgeon on call
Press 3 to connect to the dermatologist on call
Press 4 to connect to an toxicology consultation
Press 5 to connect to the infectious disease physician on call
Press 7 if the consultant you need is not listed
Press 0 to hear these options again.

We were unable to access the ___(provider type)___ on call. Your call is being directed to the on-call emergency room physician. When the call is answered, please state that you are a DEPLOYED SPECIAL OPERATIONS CAREGIVER accessing the ADVISSOR VIRTUAL HEALTH SUPPORT LINE and that you need to speak to a ___(provider type)___.

Additional specialty services are not yet available for immediate teleconsultation. Please e-mail the specialist you need according to the e-mail distribution lists in the ADVISSOR Consultation “How-To” Guide (appendix A of the ADVISSOR SOP) or at med.consult.army@mail.mil or med.dottconsult.ltd-army.mil
Read phonetically.
### Research LOEs:

1. PFC (current)
2. FST/CSH
3. CASEVAC/MEDEVAC/CCAT
4. Clinic Based Care
5. OR/Surgical
6. Medical Battlespace Monitoring (MOC concept)
7. MASCAL
8. Humanitarian aid
## Current Efforts

<table>
<thead>
<tr>
<th>Short Title</th>
<th>Description</th>
<th>Echelon</th>
<th>Funding Source</th>
<th>Grant Status</th>
<th>Study Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>BURNMAN</td>
<td>Visual Machine Learning to identify Burn Wounds Size</td>
<td>R1</td>
<td>JCP-1, $1.3M</td>
<td>Funded</td>
<td>Protocol Development</td>
</tr>
<tr>
<td>TRUMAN</td>
<td>The Trauma Medical Assistant – hands free documentation, machine learning &amp; decision support, telementoring</td>
<td>POI-R1</td>
<td>JPC-6, $1.5M/yr x 3</td>
<td>Pre-Proposal</td>
<td></td>
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<tr>
<td>J-MEDIC3</td>
<td>Program to develop prehospital documentation and telemedicine platform</td>
<td>POI-R1</td>
<td>JPC-1</td>
<td>Pending Decision</td>
<td></td>
</tr>
<tr>
<td>Virtual PFC</td>
<td>Telementoring to Improve Clinical Performance in PFC setting</td>
<td>POI-R1</td>
<td>JPC-6, $1.5M</td>
<td>Funding Recommend</td>
<td></td>
</tr>
<tr>
<td>VC3</td>
<td>Low Cost Virtual Critical Care Consultative Support to Caregivers in Austere locations</td>
<td>POI-R2</td>
<td>AAMTI, $285</td>
<td>Funded</td>
<td>Enrolling</td>
</tr>
<tr>
<td>ADVISSOR</td>
<td>Low Cost Specialty Care Consultative Support to Caregivers in Austere locations</td>
<td>POI-R2</td>
<td>AAMTI, $250K</td>
<td>Funded</td>
<td></td>
</tr>
<tr>
<td>Flying TeleICU</td>
<td>UW-MAMC-ISR collaboration to test telemedicine &amp; PCLCs during long range transport of critically ill patients</td>
<td>EVAC</td>
<td>JPC-6, $1.5/yr x 3 yrs</td>
<td>Pre-Proposal</td>
<td></td>
</tr>
<tr>
<td>TeleAware</td>
<td>TeleICU using AWARE COTS Software to improve Process and Outcomes</td>
<td>R3/4</td>
<td>JPC-1, $1M</td>
<td>Funding Recommend</td>
<td></td>
</tr>
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</table>
## Framework for Telemedical Support in the Operational Environment

<table>
<thead>
<tr>
<th>Setting</th>
<th>Capability</th>
<th>Asynchronous</th>
<th>Synchronous</th>
<th>Continuous (Synchronous with no signal loss indefinitely)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Urgent Provider Consult</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>VTC, Low DEF Interruptible</td>
</tr>
<tr>
<td>Urgent Provider Consult</td>
<td>X</td>
<td>X</td>
<td></td>
<td>VTC, High DEF Uninterrupted</td>
</tr>
<tr>
<td>Non-Urgent Patient Encounter</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Remote Monitoring (vital signs)</td>
</tr>
<tr>
<td>Optimal Critical Care Consultation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>VTC</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Procedural (surgical) Support/Mentoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

### Practice Location

<table>
<thead>
<tr>
<th>Capability</th>
<th>Location</th>
<th>Ruck</th>
<th>Truck</th>
<th>House/CSH</th>
<th>Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (Minimum)</td>
<td>Asynchronous</td>
<td>Asynchronous</td>
<td>Async</td>
<td>Async/Voice</td>
<td>Synchronous VTC LD</td>
</tr>
<tr>
<td>Better</td>
<td>Synchronous Voice</td>
<td>Synchronous Voice</td>
<td>Cont Monitoring</td>
<td>Cont VTC HD</td>
<td>Cont Monitoring</td>
</tr>
<tr>
<td>Best</td>
<td>Synchronous VTC LD</td>
<td>Synchronous VTC LD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Teleconsultation Support Technologies

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

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

PFC Capabilities

- **Capabilities** combines basic diagnostic and patient treatment skills with medical equipment to define a framework for education and training.

- 10 Capabilities:
  - Monitor the patient
  - Resuscitate the patient
  - Ventilate/oxygenate
  - Maintain an airway
  - Sedation/pain control
  - Physical Exam/diagnostic measures
  - Provide nursing/hygiene/comfort measures
  - Perform advanced surgical interventions
  - Telemedicine
  - Prepare the patient for flight

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Operational Context of PFC

- **Common operational PFC planning factors:**
  - **RUCK**: Kit medic carries to their farthest point of the mission
  - **TRUCK**: Conveyance that gets the medic to the farthest point
  - **HOUSE**: Permanent/semi-permanent structure with all organic team equipment (team house, FST site, hotel room, etc.)
  - **PLANE**: Any platform that will evacuate patient
The Tyranny of Distance... in PACOM!

DEVELOPMENT OF A CIVILIAN-MILITARY PLATFORM FOR TELEMEDICINE CARE DURING PROLONGED FIELD CARE AND EVACUATION
DoD FY16 DMRDIP JPC-6/CCCRP Precision Trauma Care Research Award 16

PI: Award Amount: $4.5M

Study/Project Aim(s)
The AirLift Northwest is an optimal platform for testing prolonged field care (PFC) and evacuation (PE) telemedical support. This joint military-civilian platform will:
- Test technologies for physiology/device related data acquisition and telemedicine to support long range civilian transport of critically ill/injured patients.
- Develop and validate protocols and infight communication interfaces to ground teams in order to optimize PFC/PE.
- Apply physiologic closed loop controller (PCLC) technologies to patients during transportation using remote supervision supported by telemedicine interfaces.

Approach
Phase 1: Integrate automated data acquisition and telemedical systems into evacuation platforms. Collect data during transports. Extend large animal ischemia-reperfusion model to survival ICU model using same systems plus PCLCs. Phase 2: Adapt infight protocols/guidelines optimized for lack of telemedical support. Prospective clinical trial. Phase 3: Prospective clinical trial of telemedical support during transportation. Implement PCLCs infight.

Goals/Milestones

2018 Goals
- Integrate automated data acquisition and telemedical hardware on extended evacuation platforms
- Passively collect data and review for consistency, reliability, and accuracy.
- Extend large animal model to >72 hour survival in an animal ICU
- Test PCLCs into animal ICU

2019 Goals
- Adapt military and civilian protocols/guidelines for long range transportation to infight protocols that would support loss of telemedical support
- Passively monitor transports with telemedical technology
- Clinical trial with/without protocols and without telemedical support

2020 Goals
- Integrate PCLCs into long range transport
- Clinical trial of outcomes following long range transport with/without telemedical support and with/without PCLCs

Budget Expenditure to Date
- Projected Expenditure: $4,500,000
- Actual Expenditure: $0

Timeline and Cost

<table>
<thead>
<tr>
<th>Activities</th>
<th>CY 18</th>
<th>CY 19</th>
<th>CY 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Phase 3</td>
<td></td>
<td></td>
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<tr>
<td>Estimated Budget ($K)</td>
<td>$1.5</td>
<td>$1.5</td>
<td>$1.5</td>
</tr>
</tbody>
</table>

Updated: 15 March 2017
Trauma Medical Assistant (TRUMAN), A pre-hospital Automated Decision Support System
DoD FY18 DMRPD JPC-6/CCCRP Precision Trauma Care Research Award 16

Pt: Award Amount: $4.5M
Org: 

Study/Product Aim(s)
TRUMAN will leverage existing advanced multiparameter imaging technology, augmented reality, voice recognition and voice-to-text capability to design a system that automatically identifies tasks performed by clinicians that may be critical for patient care.

Approach
Phase 1: Develop SCRIBE and ARTEMIS independently. Additional field observation of TCCPCP; during simulation training will be performed to develop a cognitive model and requirements for view. Phase 2 will develop the necessary CDS, including the development of libraries and algorithms. Phase 3 will field test on combat medic with and without TRUMAN using sim scenarios and the performance lab at Madigan Army Medical Center.

Goals/Milestones

<table>
<thead>
<tr>
<th>CY</th>
<th>Phase 1: TRUMAN SCRIBE and ARTEMIS design</th>
<th>Phase 2: TRUMAN VIEW and HERO design</th>
<th>Phase 3: Field testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Collect motion and audio data and identify critical task steps for automated recognition.</td>
<td>Create seamless interface</td>
<td>Complete AI-driven medical guidance and feedback decision support including finalised ML algorithms</td>
</tr>
<tr>
<td>19</td>
<td>Validate ARTEMIS using standardized TCCCP simulation models</td>
<td>Develop ML Algorithms that identify medical tasks based on critical steps and SCRIBE data.</td>
<td>Field test human performance with/without TRUMAN in limited scenario</td>
</tr>
<tr>
<td>20</td>
<td>Field observations for cognitive modeling to identify VIEW requirements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Budget Expenditure to Date
Projected Expenditure: $4,500,000
Actual Expenditure: $0

Updated: 15 March 2017

Development of a Simulation Model to Test Technologies that Improve Human Performance During Prolonged Field Care
DM160069

Pt: Pamplin, Jeremy LTC, MD, FACC, FACP
Org: The Geneva Foundation
Award Amount: $1.5 million

Study/Product Aim(s)
- Aim 1: Identify a technology platform that supports real-time telemedicine in PFC.
- Aim 2: Develop simulation training scenarios that test critical decision making during PFC.
- Aim 3: Test subject performance in PFC scenarios after standardized training with and without use of telemonitoring.

Approach
The purpose of this study is to measure clinician performance related to critical care management in prolong field care (PFC). We will create a PFC testing platform, develop and validate simulation scenarios, recruit clinicians to complete “just-in-time” training, and then measure their performance during PFC simulation scenarios with/without telemonitoring. We hypothesize that patient care provided to critically ill or injured patients during PFC by clinicians following standardized training will be inferior to patient care provided following standardized training and supported by plus real-time telemonitoring.

Goals/Milestones (Example)

<table>
<thead>
<tr>
<th>CY</th>
<th>Establish technology platform, Pilot test simulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Identify commercial off the shelf product to use as telemedicine device.</td>
</tr>
<tr>
<td></td>
<td>Install telemedicine workstations/hubs at collaborating sites (SAMMC and RAMC)</td>
</tr>
<tr>
<td></td>
<td>Develop simulation training scenarios</td>
</tr>
<tr>
<td></td>
<td>Identify and write PFC scenarios</td>
</tr>
<tr>
<td></td>
<td>Pilot test and validate scenarios using subject matter experts</td>
</tr>
</tbody>
</table>

Budget Expenditure to Date

<table>
<thead>
<tr>
<th>CY</th>
<th>Establish telemedicine platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>$800K</td>
</tr>
<tr>
<td>18</td>
<td>$579K</td>
</tr>
<tr>
<td>19</td>
<td>$119K</td>
</tr>
</tbody>
</table>

Updated: 17 August 2016
Implementation of the AWARE system to support virtual critical care in a MEDCEN and CSH.

**Study/Product Aim(s)**
Using a combination of novel analytics and visualizations of electronic medical data, local workgroup initiated process improvement projects, virtual audits of quality metrics, and daily review of process and outcomes reports by bedside and virtual clinician’s, rapidly improve process adherence and patient outcomes in an adult intensive care unit. Demonstrate that this technology and approach to ensuring high quality patient care can be used in a deployed setting.

**Approach**
We will use the paradigm of structure, process, and outcome standardization and metric monitoring to improve care in the intensive care unit using teleICU technologies that have recently advanced to the point they are ready for supporting clinical medicine in a fixed and deployed facility.

**Goals/Milestones**
- CY16 – Installation Phase
  - Submit application for Certificate of Needworthiness (CON) for IDEA System
  - Submit application for CON for AWARE system
  - Identify critical care stakeholders to write/write clinical practice guidelines (CPGs) that include process and outcomes measures
  - CY17 – Complete Installation, Start Operation Phase and Expansion Phases
    - Install hardware in ICU rooms and create remote workstation
    - Complete CPGs
    - Provide remote services and audit quality metrics
    - Measure impact of virtual critical care service on process adherence and patient outcomes
    - Work with 47th CSH to test virtual support during FTX.
    - CY18 – Complete Operation Phase and Expansion Phases
    - Measure impact of intervention on clinician-performance and patient outcomes
    - Test virtual presence during FTX

**Timeline and Cost**

<table>
<thead>
<tr>
<th>Activities</th>
<th>CY 16</th>
<th>CY 17</th>
<th>CY 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install virtual monitoring capability at Madigan Army Medical Center.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Develop CPGs, implement virtual critical care service, and measure impact on associated processes and outcomes</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Test capability with 47th CSH during FTX</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Estimated Budget (SK)</td>
<td>$78.1</td>
<td>$606.2</td>
<td>$253.9</td>
</tr>
</tbody>
</table>

Updated: 19 April 2016

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Burn Medical Assistant (BURMAN)

**Study/Product Aim(s)**
- Enable clinicians to:
  - Use non-invasive multispectral imaging systems to capture burn data from imperfectly positioned patients
  - Use advanced machine learning techniques to determine multispectral signatures that characterize burn depth
  - Determine burn size and location from imagery and accurately map the wound to a standard Lund Browder diagram
  - Improve a novice’s estimation of burn wound size/depth to within 5% of an experienced clinician’s estimation

We will utilize a combination of multispectral images developed by Raytheon Vision Systems and Microsoft Kinect® to capture burn wound images and synthesize these images onto a standard Lund-Browder burn diagram. Machine learning will be used to develop a model to predict wounds based on image data.

**Goals/Milestones (Example)**
- CY16 Goals – Baseline data collection
  - Deliver Raytheon imagers for burn image data capture
  - Obtain IRB and IACUC Protocol Approvals
  - Start collecting imaging data of burn wounds at the USAISR Burn Center
  - Develop enhanced burn wound diagrams for wound estimates
- CY17 Goal – Model Burn Wound Predictions
  - Generate burn wound severity data using enhanced diagrams
  - Create machine learning algorithms to predict burn wound severity
- CY18 Goal – Design and Test Prototype BURMAN
  - Design mobile imaging system

**Timeline and Cost**

<table>
<thead>
<tr>
<th>Activities</th>
<th>CY 16</th>
<th>CY 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create de-identified database of enhanced burn wound diagrams</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Export annotations of enhanced burn wound diagrams</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Create a Machine Learning Model</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Produce a reference design for a mobile platform</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Estimated Budget (SK)</td>
<td>$604k</td>
<td>$518k</td>
</tr>
</tbody>
</table>

Updated: 24 November 2015

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