Emerging Consciousness: A Hopeful Recovery Model

Presented by:
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April Cerqua, LCSW
Bryan Haese, RN
Objectives

• Define emerging consciousness
• Understand medical considerations that commonly impact EC patients
• Identify the benefits of using the interdisciplinary approach with this patient population
Emerging Consciousness (EC)
Case Presentation

- 31 yo male Veteran, helmeted moped driver
- Traveling 35 mph, cobblestone street
- Lost control, helmet fell off prior to impact
- Per witness, moped rolled causing multiple impacts head to cobblestone
- LOC at the scene
- Initial GCS 8
- Patient intubated
EC Case Presentation

- **Injuries included:**
  - Hemotympanum, left eye periorbital ecchymosis, knuckle abrasions
  - Bilateral SDH and SAH
  - Bilateral basilar skull fractures, LeForte III fracture, bilateral temporal bone fractures, left pterygoid plate fracture, left sphenoid fracture, bilateral superior orbital rim fractures, nasal bone fracture
EC Case Presentation

- Ventilator status; GCS 3T
- ICP elevated; EVD placed, then bilateral craniectomy performed
- Fever, broad spectrum antibiotics; cultures no growth
- Dysautonomia
- Right calf DVT; Lovenox and IVC filter
- Possible seizure on video EEG; Keppra
EC Case Presentation

- Trach and PEG placed
- Fever again: courses of multiple antibiotics
- Anemia, patient transfused
- Abdominal hematoma (site of bone flap implantation); Lovenox held; later warfarin added
- ? Some command following, tracking
- Trach removed; reported GCS “12”
- Transferred to Minneapolis VA EC Program
EC Case Presentation

- **PMH:** PTSD, low back/shoulder pain, migraines

- **SH:** married, 2 young children; former Marine; construction work, (firefighter); parents nearby

- **Habits:** 6 pack beer every few weeks; occasional tobacco; some marijuana

- **Meds:** Keppra 500mg bid; Propranolol 10mg bid; Warfarin 5mg; Miralax, bisacodyl supp, artificial tears, prn acetaminophen
EC Case Presentation

• Admission exam:
  ▫ Patient diaphoretic
  ▫ Heart rate 121; Temp 100.9 F; O2 sat 94%
  ▫ Significant bilateral sunken flap at crani sites
  ▫ Loud snoring, reduced oral secretion management; lungs w/ rhonchi
  ▫ Abdomen w/ large area hematoma and bruising, 6 cm incision, inflammation at bone flap site, serosanguinuous drainage noted
EC Case Presentation

• Admission exam continued:
  ▫ Left pupil nonreactive, right pupil sluggish; no gag or cough reflex
  ▫ Extensor posturing/decerebrate posturing
  ▫ Normal tone w/ PROM when not posturing
  ▫ Nonverbal, no command following
  ▫ Does appear to slightly awaken to tactile stimuli
EC Case Presentation

- EC Program, Medical Comorbidities:
  - Sleep/Wake Cycle
  - Seizures
  - Dysautonomia
  - Tachy/Bradycardia; Hyper/Hypotension
  - DVT or PE
  - Motor restlessness/Hyperkinesia/Tremor
  - Hypertonia/Spasticity
  - Hydrocephalus, SDH, etc
EC Case Presentation

• EC Program, Medical Comorbidities:
  ▫ Infection or Sepsis; CNS infection
  ▫ Respiratory Dx (Pneumonia/Respiratory Tract Infection, Trach)
  ▫ Apnea
  ▫ Wounds; Rash
  ▫ Endocrine or Electrolyte abnormalities
  ▫ Osteomyelitis; Heterotopic Ossification
  ▫ Pain (headache)
EC Case Presentation

- EC Program, Medical Comorbidities:
  - Urinary tract infection; kidney stones
  - Bowel obstruction, C Diff, Cholecystitis
  - GE Reflux; Emesis
  - Nutritional status
  - Hypermetabolic state
  - Neuropathy or Myopathy
  - Rash/MRSA skin involvement
  - Vision/Hearing; CN injury
EC Case Presentation

• EC Program, Medical Comorbidities:
  ▫ Sunken Skin Flap Syndrome (SSFS) or The Syndrome of the Trephined
  ▫ Delayed complication of craniectomy
  ▫ Atmospheric pressure exceeding ICP
  ▫ Sunken appearance at craniectomy site
  ▫ Severe headache (if patient aware)
  ▫ Neuro deficits, seizures, change mental status
  ▫ Possible paradoxical herniation
EC Case Presentation: Imaging

VA Admission CT
EC Case Presentation: Imaging

Sagittal

Coronal
EC Case Presentation: Imaging

Cranioplasty
EC Case Presentation: Imaging

3 weeks post-op

Recent
What does Emerging Consciousness mean?

Arousal

Coma  VS  MCS  Consciousness

Awareness
How do we know if someone has emerged from an altered state of consciousness?

- **Reliable and consistent interactive communication**
  - Accurate yes/no responses to six of six basic situational questions on 2 consecutive evaluations (can be via speech, writing, yes/no signals, or AAC)
    - Aspen Criteria (Giacino J, 2002)

- **Functional object use**
  - Appropriate use of at least 2 functional objects on 2 consecutive evaluations
    - Aspen Criteria (Giacino J, 2002)

- **Consistent behavioral manifestation of a sense of self in the environment**
  - Those who are apraxic and aphasic
Emerging Consciousness Program

- 90 day rehabilitation admission
- Aims to optimize long term functional outcomes by
  - Regulating and systematically monitoring responses of sensory and environmental stimulation
  - Managing medical comorbidities to prevent secondary complications
- Interdisciplinary care including
  - Intensive family support/education
  - Social work case management
- Inclusion Criteria
  - Within first 2 years of injury
  - Medically stable to transfer to facility
  - Functioning in a coma, vegetative, or minimally conscious state
Emerging Consciousness Clinician Pathway

**Getting Started (Week 1-3)**

Initial evaluations initiated. Family contact meeting arranged with tailored team members to family needs. Treatment protocol initiated and schedule maximized based on patient’s tolerance and abilities. If medical issues pervasive, this period will include attempts to stabilize medical conditions to maximize therapy effect. Based on findings from evaluations, team will place pt on Pathway I, II, III.

**Pathway I**
- Patient is not expected to emerge from a disordered state of consciousness within the 12 week program.
- Patient is showing no or little change from baseline measures.
- Discharge will be facilitated to home or facility that can meet the long term care needs of the patient based on families’ guidance.

**Pathway II**
- Patient is expected to emerge from a disordered state of consciousness within the 12 week program.
- Patient is making slow but steady progress in physical and cognitive domains.
- Length of stay may be extended beyond initial 12 weeks based on family and patient needs.

**Pathway III**
- Patient is expected to emerge from a disordered state of consciousness within the 12 week program.
- Patient is making steady progress in physical and cognitive domains.
- Length of stay may be extended beyond initial 12 weeks based on family and patient needs.

**Treatment Phase (Week 4-8)**

- Therapy schedule should be maximized to accommodate pt’s needs and abilities. All Pathway’s will receive therapy tailored to the patient’s needs. Monitoring of specific drug trials to occur during this period. A patient may emerge during this time period and will be placed on the appropriate pathway based on their progression.

**Moving Forward (Week 9-12)**

- This phase involves tailoring the patient’s treatment to the discharge location. Treatment will be modified to meet the discharge recommendations of the team for the referring facility. If patient is going home, this will be an intense family training period. Program management will use projected patient pathway and actual patient pathway for outcome tracking.
### Coma Recovery Scale-revised

<table>
<thead>
<tr>
<th>Coma Recovery Scale-revised</th>
<th>Pre cranioplasty (4 weeks)</th>
<th>Post cranioplasty 1-2 weeks</th>
<th>Post cranioplasty 3-4 weeks</th>
<th>Post cranioplasty 5-6 weeks</th>
</tr>
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<tbody>
<tr>
<td><strong>Total score</strong></td>
<td>2-3</td>
<td>2-4</td>
<td>9-10</td>
<td>19-20</td>
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<tr>
<td><strong>AUDITORY FUNCTION SCALE</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4-Consistent movement to command*</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3-4</td>
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<tr>
<td>3-Reproducible movement to command*</td>
<td></td>
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<tr>
<td>2-Localization to sound</td>
<td></td>
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<tr>
<td>1-Auditory startle</td>
<td></td>
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<tr>
<td>0-None</td>
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<tr>
<td><strong>VISUAL FUNCTION SCALE</strong></td>
<td></td>
<td>(1)</td>
<td>3</td>
<td>5</td>
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<tr>
<td>5-Object recognition*</td>
<td></td>
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<tr>
<td>4-Object Localization*</td>
<td></td>
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<tr>
<td>3-Visual pursuit*</td>
<td></td>
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<tr>
<td>2-Fixation*</td>
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<tr>
<td>1-Visual startle</td>
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<tr>
<td>0-None</td>
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<td><strong>MOTOR FUNCTION SCALE</strong></td>
<td></td>
<td>1</td>
<td>1-2</td>
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<tr>
<td>6-Functional object use**</td>
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<tr>
<td>5-Automatic motor response*</td>
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<tr>
<td>4-Object manipulation*</td>
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</tr>
<tr>
<td>3-Localization to noxious stimulation*</td>
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<tr>
<td>2-Flexion withdrawal</td>
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<tr>
<td>1-Abnormal posturing</td>
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</tr>
<tr>
<td>0-None/Unarousable</td>
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<tr>
<td><strong>OROMOTOR/VERBAL FUNCTION SCALE</strong></td>
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<tr>
<td>3-Intelligible verbalization*</td>
<td>1</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2-Vocalization/Oral movement</td>
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<tr>
<td>1-Oral reflexive movement</td>
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<td>0-None</td>
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<td><strong>COMMUNICATION SCALE</strong></td>
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<tr>
<td>2-Functional; Accurate**</td>
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<td></td>
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</tr>
<tr>
<td>1-Non-functional; Intentional*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-None</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>AROUSAL SCALE</strong></td>
<td></td>
<td>(1)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3-Attention</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Eye opening w/o stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Eye opening with stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-Unarousable</td>
<td></td>
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</table>

*denotes MCS

**denotes emergence from MCS
### Disorders of Consciousness Scale (DOCS-25)

<table>
<thead>
<tr>
<th></th>
<th>Pre cranioplasty (4 weeks)</th>
<th>Post cranioplasty 2 weeks</th>
<th>Post cranioplasty 4 weeks</th>
<th>Post cranioplasty 6 weeks</th>
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<tbody>
<tr>
<td>Total Score</td>
<td>6</td>
<td>17</td>
<td>22</td>
<td>26</td>
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<tr>
<td>Social greeting</td>
<td>0</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Follow 1 step command</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Name called</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Orientation to self</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Orientation to environment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Toothbrush</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Juice to lips and tongue</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Odor</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Masseter massage</td>
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<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sweet/sour taste</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Focus on face</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Focus on object</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Tracking face</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Tracking object</td>
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<td>2</td>
<td>2</td>
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<tr>
<td>Cold spoon</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Vibration to toe</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Ice cube to toe</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Feather</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Joint ROM</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Air</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Hand massage</td>
<td>1</td>
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<td>0</td>
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<tr>
<td>Heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Scrub to arm</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alcohol swab to toe</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hair</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

0 = No response
1 = Generalized response
2 = Localized response
<table>
<thead>
<tr>
<th>Post-Acute Loss of Consciousness scale (PALOCs)</th>
<th>Pre cranioplasty (4 weeks)</th>
<th>Post cranioplasty 2 weeks</th>
<th>Post cranioplasty 4 weeks</th>
<th>Post cranioplasty 6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>1-2</td>
<td>2-3</td>
<td>3-5</td>
<td>7-8</td>
</tr>
<tr>
<td><strong>1- Coma</strong></td>
<td>Eyes are closed all the time. No sleep wake cycle.</td>
<td></td>
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</tr>
<tr>
<td><strong>2- Vegetative State (hyporesponsive)</strong></td>
<td>Generally no response to stimulation, possible delayed reflexive responses.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>3- Vegetative State (reflexive state)</strong></td>
<td>Stimuli results in massive stretching or startle reactions, mass patterning, roving eye movements without tracking.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4-Vegetative State (high active)</strong></td>
<td>Generally spontaneous unidirectional movement, retraction of limb following stimulation, orientation toward a stimulus without fixating, following movement of people or objects without fixation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5- Minimally Conscious State (transitional)</strong></td>
<td>Following and fixation of persons and objects, More directed reactions to stimuli, behavior is automatic.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6- Minimally Conscious State (inconsistent reactions)</strong></td>
<td>Occasional obeys simple commands, level of alertness fluctuates but is generally low.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>7- Minimally Conscious State (consistent reactions)</strong></td>
<td>Alertness level is high and stable, obeys simple commands.</td>
<td></td>
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</tr>
<tr>
<td><strong>8- Consciousness</strong></td>
<td>Alert, functional mutual communication, appropriate interactions with environment.</td>
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</table>
Introduction

• Severe brain injury can cause a profound disturbance of consciousness (DOC).
• Typical evaluation of the level of consciousness relies on subjective behavioral assessment of patients’ responsiveness using clinical scales.
• The determination of the level of consciousness has important ethical and medical consequences in regard to the selection of care, treatment, and end-of-life decisions. For these reasons, it is important to have an objective method that assists practitioners in determining the presence of willful brain activity even when patients are not able to demonstrate a willful response.
• The current study aims to develop an objective method of evaluation of willful brain activity in disorders of consciousness using electroencephalography (EEG).

Methods

• Preliminary resting state EEG data (5 minutes, 8 electrodes) were collected from two neurologically healthy controls and two patients (both males; 21 and 31 years-of-age) who had a severe traumatic brain injury as a consequence of a vehicular accident. The recordings for the two patients were done while in Minimally Conscious State (MCS) and again several weeks later while they emerged from MCS (i.e., MCS+).
• Power spectral density (PSD) and phase-locking index (PLI; a measure of the strength of phase synchronization between oscillatory activities from two different locations) were calculated in different frequency bands (delta, theta, alpha, beta).

Results

• Fig. 1. The PSD profiles for both patients in MCS decreased progressively across frequency bands without noticeable characteristics. In contrast, the PSDs in MCS+ state had a strong beta-band peak (~20 Hz), whereas those of Controls had a clearly defined alpha-band peak (~10 Hz).
• Fig. 2. For PLI, we found that both short- and long-range interactions were significantly weaker in MCS than MCS+ and Controls. In addition, the long-range interactions were significantly weaker than short-range in MCS (bootstrap t-test, p<0.05), but not in MCS+ and in Controls.

Conclusions

The results indicate that (1) the profile of the resting state PSD can be used to differentiate the level of consciousness of DOC patients, and (2) functional connectivity measures may provide valuable information in the assessment of DOC patients.
• These preliminary results support the idea that the analysis of neural oscillatory activity with EEG can provide a sound basis for evaluating the level of consciousness of an individual, and monitoring changes in that level over time.
Therapist Roles

• Monitor responsiveness and customize program to patient’s strengths

• Prevent comorbidities associated with immobility

• Family education
Nursing with EC patients

- Intensive collaboration with physicians and other members of interdisciplinary team to monitor complex medical care and rehab goals

- Reading patient’s nonverbal signs for pain, fatigue and responses
  - Developing scheduled breaks based on fatigue and tolerance to therapy – optimize participation
Nursing Role with EC Patients

- Tracking trends of nonverbal signs to optimize recovery and care
  - Agitation, heart rate, blood pressure, perspiration
- Continuity of care by assigning primary nurses
- Ability to provide highest level of care due to patient requiring total assistance
- Encouraging family involvement in rehabilitation path
Patient and Family-Centered Care

• Comprehensive training and education provided to family/caregivers throughout EC stay
• 24/7 support provided to patient and family who is often bedside
• Collaboration and involvement of patient’s care
• Managing expectations for rehabilitation
• Providing compassionate care to family
  ▫ Dynamic family mood and emotions
• Accommodating special requests when appropriate.
Assistive Technology and Integrative Therapies

- **AT**
  - Seating system
  - Communication system
  - iPhone/iPad – alarms, schedules, tasks

- **Integrative therapies that nursing uses with EC patients**
  - Essential Oils – calm, ache-ease, tum-ease
  - Healing Touch Therapy
  - Battlefield Acupuncture
  - Cultural Rituals
Caregiver support and discharge planning

• Family Psychologist and Social Work Case Manager integrated in the care team
• Provides setting to process grief, fear, uncertainty about future
• CM anticipate needs in terms of financial concerns, benefits, planning for next steps
• Introducing discharge planning from admission
VA Polytrauma System of Care

• Centers in Minneapolis, Richmond, Tampa, San Antonio, Palo Alto
  ▪ Inpatient acute rehab unit (PRC)
  ▪ Residential rehab unit (PTRP)
  ▪ Outpatient brain injury rehab program
• All programs are CARF accredited
• Traditional rehab team with addition of AT engineer and seating specialist, vision therapist, psychiatrist, neuropsychologist, rec therapists, Military CM/Liaisons for Active Duty SM
Moving Forward - A System of Care

- Veteran moved through system of care
  - EC and Acute Rehab (PRC)
  - Residential Rehab (PTRP)
  - Outpatient Rehab (Hines VA PNS) (voc rehab, driving rehab, rec therapy)
- Long term case management and TBI clinic support for veteran and family
- Opportunities for adaptive sports and leisure
How to refer

• Minneapolis VA Polytrauma Brain Injury Admission Point of Contact:
  ▫ April Cerqua, LCSW
  ▫ (612)467-5213
  ▫ April.Cerqua@va.gov

• General Referrals to Minneapolis VA:
  ▫ Referral Line: (612)467-2019
Questions?