Neurobehavioral Impairments & Post-hospital Rehabilitation: Medical and Behavioral Approaches

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Introduction: Behavior is defined as…

Is this behavior “normal” for a pig?

- Behavior is a “range of actions” made by an organism in conjunction with their environment (may include psychosocial variables)

- It is also a response of the system or organism to various stimuli or inputs

- Neurological Behaviors are those that occur in response to neurological injury severity, injury location, and psychosocial variables of the individual
Learning Objectives

Participants will learn about…

• Underlying neuropathology leading to behavioral dysregulation
• Rehabilitation treatments within a rehabilitation model of care
• Medical interventions for behavior dysregulation (e.g., evidence for medication management)
• National trends and neurobehavioral outcomes

• Addendum:
  – Behavioral strategies / interventions, and environmental control
Some think…

Behavior seems like tug of war…
It’s not, when you understand the root cause of the behavior.
Learning Objectives

Underlying Neuropathology leading to behavioral dysregulation

Primary and Secondary causes
Behavior is Multifaceted

- Behavior, whether from a neurological injury or from another event or medical condition, is **highly complex**.

- **Most behaviors involve cognitive processing**, conditions of the behaviors, other persons including family, social aspects, financial aspects, and legal considerations.

- Example: *Why do people stop at stop signs?* Is it to prevent getting a ticket, to prevent injury, or to prevent feeling guilty for running the sign?
Challenge is Etiology

For neurological injuries, the challenges that are faced by patients, support systems and professionals are varied. However, the challenges can be categorized for ease of understanding.

**Categories:**
- Biological/Biochemistry – cellular level; repair and plasticity
- Neuropathology – tissue, physiology level
- Neurobehavioral – individual level
- Neurocognitive – individual level
- Psychosocial variables – individual and environmental levels

**Example: residual behavior that could be multifaceted!!**
- Agitation can be caused by biochemistry – dopamine
- Agitation can be caused by physiology – frontal and temporal pathology
- Agitation can be caused by behavior – not getting what one wants
- Agitation can be caused by psychosocial – interaction of rehab environment and family and environmental demands
**Neuropathology - Primary**

**Frontal:** results in cognitive, emotional, and behavior dysregulation. (Dimasio and Dimasio, 1990-2000; University of Iowa).

- Think of this massive region (30% of the brain mass) as the regulator and manager of the entire system
- Differences of left vs. right injury; differences with orbitofrontal vs. lateral vs. ventral.
- Social dysregulation; social awareness impairment; overestimation of skills and underestimation of deficit

**Temporal:**

- Memory impairment due to unilateral or bilateral involvement.
- Kluver Bucy Syndrome: rare behavior impairment due to bilateral damage of the anterior temporal lobes; hyper orality, inappropriate sexual behavior, agnosia, loss of normal fear and anger responses, memory loss, dementia
Neurological Trauma – Behavior as part of recovery

**Severe Injury**: at this level, behaviors tend to be primitive, responsive to the environment, and sensitive to changes. Ranchos Scale Level IV-V (agitated and confused; easily overwhelmed by environmental stimuli). Amenable to medication and environmental control for safety and reducing injury or falls.

**Moderate Injury**: at this level, behaviors transition quickly from reactions or responses to the environmental demands, person demands, or cognitive challenges. Rancho level V-VII (confused, disoriented, easily overwhelmed but non-agitated). Responses tend to be simple and become complex with recovery. Amenable to medication and environmental control.
Neurological Trauma Behaviors

**Mild Injury:** at this level, injury is also responsive to the environment and persons in the environment. However, **cognitive processing** becomes more prominent in management and control of conditions. Rancho Level VII-VIII and beyond. Concussions fall in this category. **Fatigue** has a significant impact on behavior control. Cognitive processing and fatigue can be amenable to **medications**.

**Post-Acute:** at this level, behaviors have developed a pattern, and responses are based on **cognition, responses to others, and environmental control**. Patterns learned tend to be problematic if early intervention is not provided. “Old Behaviors” tend to resurface (both positive and negative).
Psychiatric influence on behaviors (brain chemistry)

- **Depression and Anxiety** are the primary psychiatric concerns related to outcomes and may result in behavior changes.

- **Brain Injury Rates:** Depression rate is 34% in current study
  - Depression had a significant effect on outcomes
  - Greater depression = greater dysfunction at discharge
    - With injury, depression may be as high as 26% and anxiety as high as 24% (Fann et al., 1995). Chaudhry et al (2013) and Lewis & Horn (2013) found depression rates as high as 34%.
    - Rate of suicide **may be higher** following injury. Risk factors to identify.

- **Brain Injury Results:** Anxiety ranges from 20-70%. Current study 42%
  - Anxiety had a significant effect on outcome
  - Greater anxiety = greater dysfunction at discharge
Neuropathology - Secondary

• Pre-existing health related concerns, such as diabetes and hypertension, have an adverse reaction to neurology and TBI in all phases, and behaviors associated with TBI (diabetics can become easily agitated with glucose changes).

• Combination of diabetes and traumatic brain injury has the potential to reduce the lifespan up to 25 years due to medication behavior non-compliance.

• To complicate factors, undiagnosed hypopituitarism can occur in up to 25% of cases following TBI. This can account for multiple behavioral and psychiatric and medical impairments (misdiagnosed depression, hypothyroidism and hyperthyroidism).
• Medical health prior to TBI (diabetes, HTN)
• Previous psychiatric and current psychiatric condition(s)
  – depression and anxiety are the most common
    • Lewis & Horn, 2017 (depression)
    • Horn & Lewis, 2017 (anxiety)
  – general population (approximately 20% incidence)
  – TBI population (approximately 34% incidence)
• Living Arrangements
• Family - Culture - Dynamics
• Education level and achievement
• Occupational history/level
• Substance abuse – without intervention, substance use rate typically returns by 2 years
• Financial considerations – resources for care
• Legal considerations
A Neurobehavioral Syndrome has been described in the literature for years. It includes a specific region of the brain and negative behavioral outcomes.

Injury must be > 8 months duration

The following behavioral features are present at least mildly:

- Irritability, Agitation, and Aggression
- Impaired Awareness
- Impaired Social Interaction
- Impaired Problem Solving

* Impaired initiation / inhibition skills may also factor into this syndrome of impairment

Rehabilitation treatments …

Model of Care
Results of Rasch Analysis for Rehabilitation Modeling

Sample Size = 1,710 (2016)

+2 (SD)

AUDITION
DIZZINESS

+1 (SD)

MOTOR SPEECH
PAIN/HEADACHE, VISION
USE OF HANDS, INAPPROPRIATE SOCIAL, IRRITABILITY, SYMPTOM SENSITIVITY
DEPRESSION, FUND OF INFORMATION, VISUAL PERCEPTION,
ANXIETY, FATIGUE, MOBILITY, NON-VERBAL COMM, VERBAL COMM

-0-

SELF-CARE
FAMILY FUNCTION
INITIATION, PRODUCTIVITY
ATTENTION, IMPAIRED AWARENESS, MEMORY
NOVEL PROBLEM SOLVE, SOCIAL CONTACT
LEISURE

-1 (SD)

MONEY MANAGEMENT

HOME SKILLS

TRANSPORTATION USE

-2 (SD)
New Evidenced Based Model – Phase A

High Impact/Low Probability Barriers
Audition, Dizziness, Motor Speech, Pain/Headache, Vision, and Hands Use

In this first level of care, the focus is on symptom management with reduction. These symptoms are considered “high impact - low probability”. This means that they are not likely to occur based on the model findings. However, when they are present, any of these symptoms are likely to create a significant functional impairment (e.g., disruption) causing greater dysfunction, and likely a longer length of stay than the overall impact of the injury alone.

In particular, the symptoms of Audition (hearing impairment) and Dizziness have the highest impact on rehabilitation outcomes.
New Evidenced Based Model – Phase A

High Impact/Low Probability Barriers

Audition, Dizziness, Motor Speech, Pain/Headache, Vision, and Hands Use

Therefore, the team that assesses the individual for rehabilitation goal setting would conclude that this is the first level of deficit to address.

By addressing these concerns (if they exist), then other concerns are secondary until either the dysfunction is remediated or compensatory strategy use is well underway.

Goal: Focus for ALL Therapies: remediate with compensatory strategy use until this level can reduce to a mild level of functional impact (e.g., <25% of the time the limitation is present).
Medium Impact / Medium Probability Barriers

Inappropriate Social Awareness, Irritability, and Sensitivity to Symptoms

In this second level, the focus is based on neurobehavioral concerns. Research by Lewis and Horn (2014) revealed that behavioral impairments have a substantial impact upon recovery. In fact, the impact can cause 2-3xs increased length of stay within a similar sample.

Further, a neurobehavioral profile was developed that significantly separated those with behavioral impairments from those with greater neurorehabilitation needs without significant behavioral disturbances.
New Evidenced Based Model – Phase B

Medium Impact / Medium Probability Barriers

*Inappropriate Social Awareness, Irritability, and Sensitivity to Symptoms*

By addressing these concerns as proactively as possible, then the largest level of care can remain on target for successful discharge.

**Goal:** Focus for ALL Therapies: remediate with compensatory strategy use until this level can reduce to a mild level of functional impact (e.g., <25% of the time the limitation is present).
New Evidenced Based Model – Phase C

Integrated treatment – Multifocal Remediation & Compensation
(Largest point of care)

DEPRESSION, FUND OF INFORMATION, VISUAL PERCEPTION,
ANXIETY, FATIGUE, MOBILITY, NON-VERBAL COMM, VERBAL COMM
SELF-CARE
FAMILY FUNCTION
INITIATION, PRODUCTIVITY
ATTENTION, IMPAIRED AWARENESS, MEMORY
NOVEL PROBLEM SOLVE, SOCIAL CONTACT

These variables are goals that move toward improvement, rather than being
seen as barriers to recovery. The only exceptions are depression and
anxiety – both have been found to reduce the total gains made in treatment
(Lewis & Horn, 2016).
New Evidenced Based Model – Phase C

Integrated treatment – Multifocal Remediation & Compensation

By addressing these concerns using the same methodology as noted in Phase A (e.g., treat in order of levels), then successful outcomes can be achieved. The goal is that multiple disciplines integrate the rehabilitation focus.

Goal: Focus for ALL Therapies: remediate and use compensatory strategies until this level can reduce to a mild level of functional impact (e.g., <25% of the time the limitation is present).
New Evidenced Based Model – Phase D

Skills Application Phase

Leisure, Money Management, Home Skills, and Transportation Use

This phase is based on the construct of Instrumental Activities of Daily Living (I-ADLs).

These are the skills that tend to be resistant to change, which is one of the reasons why the prior levels must be either underway or achieved to make a significant change in this phase.

In addition, self-care and initiation, both factor into this phase of community success (Lewis & Horn, 2015). If behavior impairment is high, then self-care skills are severely limited and initiation becomes impaired.
Medical Interventions – Neurobehavioral Impairments

Medical interventions for behavior dysregulation

Evidence for medication management
Pharmacologic Interventions

In people with TBI, medications can address:
- Insomnia
- Attention and processing speed
- Fatigue/sleepiness
- Initiation
- Depression
- Anxiety
- Pseudobulbar affect
- Emotional/affective lability
- Irritability/Aggression

Note: All medication uses discussed are off-label except antidepressants for depression and benzodiazepine, buspirone, and some antidepressants for anxiety.
Pharmacologic Interventions

Insomnia: Evidence in TBI

**Melatonin**: one positive RCT (Grima et al, 2018)

**Trazodone**: no RCT’s, in common use

**Sedating tricyclic antidepressants** (nortriptyline, amitriptyline): when pain is an issue

**Zolpidem** (Ambien): no RCT’s, may cause cognitive impairment in AM, especially at 10 mg dose (Larson & Zollman, 2010)

**Zaleplon** (Sonata): no RCT’s; no AM cognitive effects when given in evening, but yes if given in the middle of the night (Larson & Zollman, 2010)

**Benzodiazepines**: no RCT’s, best avoided, can cause attention & memory disorders (Dawson et al, 2008)
Pharmacologic Interventions

Attention and processing speed: Evidence in TBI


**Lisdexamfetamine** (Vyvanse): prodrug for dextroamphetamine; some evidence: 1 RCT (Tramontana et al, 2014)

**Amphetamines** (e.g., Adderall, Dexedrine): not well-studied, one negative RCT, but are used (Hart et al, 2018)

**Amantadine**: little evidence, but is used; one negative RCT in irritable patients (Hammond et al, 2018); however, speeds recovery in patients in MCS (Giacino et al, 2012)

**Atomoxetine** (Strattera): one negative RCT (Ripley et al, 2014)

**Acetylcholinesterase inhibitors** (e.g., donepezil, rivastigmine, galantamine): RCT’s mixed (Zhang et al, 2004; Silver et al, 2006; McAllister et al, 2016)
Pharmacologic Interventions

Fatigue/sleepiness: Evidence in TBI

**Modafinil** (Provigil): mixed evidence, one positive RCT, probably helps (Kaiser, 2010; Jha et al, 2018)

**Armodafinil** (Nuvigil): one RCT’s, partially positive, probably helps (Menn et al, 2014)


**Amphetamines**: no RCT’s, probably helps

**Amantadine**: no RCT’s, probably helps
Pharmacologic Interventions

Initiation: Evidence in TBI

Methylphenidate: one positive RCT (Kant et al, 2002)
Lisdexamfetamine: one positive RCT (Tramontana et al, 2014)
Amphetamines: no RCT’s, probably help
Amantadine: no RCT’s, probably helps; however, speeds recovery in patients in MCS (Giacino et al, 2012)
Modafinil: no RCT’s, probably helps
Armodafinil: no RCT’s, probably helps
Pharmacologic Interventions

Depression: Evidence in TBI

**Overall**: meta-analysis-mixed results, overall positive (Salter et al, 2016)

**SSRI’s** (e.g., sertraline, fluoxetine, citalopram): mixed results, probably work

**SNRI’s** (e.g., venlafaxine, duloxetine): no studies, probably work

**Tricyclic antidepressants** (e.g., desipramine, nortriptyline): one positive RCT

**Other antidepressants**: no studies

**Methylphenidate**: some positive studies (Lee et al, 2005; Zhang & Wang, 2017-RCT; Johansson et al, 2020-RCT)
Pharmacologic Interventions

Anxiety: Evidence in TBI

**Benzodiazepines** (e.g., diazepam, lorazepam, clonazepam): no RCT’s, best to avoid if possible, cause memory & attention disorders

**Buspirone** (Buspar): no RCT’s

**SSRI’s/SNRI’s**: no RCT’s, may be best choice
Pharmacologic Interventions

Pseudobulbar Affect (pathological laughing & crying): Evidence in TBI

**PBA**: Paroxysmal stereotyped laughing & crying with little or no provocation

**Antidepressants** (SSRI’s preferred)

**Methylphenidate**

**Anticonvulsants** (lamotrigine, valproate, carbamazepine)

**Levodopa**

**Amantadine**

**Dextromethorphan/quinidine** (Nuedexta-FDA approved for PBA)

- Open label study-improvement and good tolerance (Hammond et al, 2018)
- Did not distinguish affective lability from PBA (Engelman et al, 2014)

(Arciniegas & Wortzel, 2014)
Pharmacologic Interventions

Emotional/Affective lability: Evidence in TBI
AL: Displaying intense emotions in response to meaningful stimuli that ordinarily would induce more modest emotional responses
Little evidence:
Antidepressants (SSRI’s preferred)
Methylphenidate
Anticonvulsants (lamotrigine, valproate, carbamazepine)
Levodopa
Amantadine
Dextromethorphan/quinidine

(Arciniegas & Wortzel, 2014)
Pharmacologic Interventions

Disinhibition/Aggression: Evidence in TBI

**Amantadine**: RCT’s partially positive (Hammond et al, 2014, 2015, 2017)

**Beta-blockers** (propranolol, pindolol, nadolol): some positive RCT’s (Greendyke & Kanter, 1986; Plantier et al, 2016)

**Valproic acid** (Depakote): no RCT’s, but commonly used (Cochrane Review, 2010)

**Levitiracetam** (Keppra): may **cause** irritability/aggression

**Other anticonvulsants** (carbamazepine, lamotrigine): (Cochrane Review, 2010)

**Lithium**: case series only

**Buspirone** (Buspar): uncontrolled studies only

**Atypical antipsychotics** (e.g., aripiprazole, quetiapine, olanzapine): no RCT’s, but commonly used, especially for short-term; especially useful with psychosis

**Typical antipsychotics** (e.g., haloperidol): no RCT’s, best to avoid unless psychosis

**Benzodiazepines**: no RCT’s, best to avoid, cause memory & attention disorders
National trends
&
Neurobehavioral outcomes
The Adjustment Index (neurobehavioral features) shows greater impairment upon admission and continued impairment is noted in the moderate range at discharge.

Research shows that once an individual meets criteria for neurobehavioral impairment, then the risks for this condition remain unchanged through the lifetime following neurological compromise.

The program shows equal impairment with Abilities (physical, cognitive and communication) and Adjustment (neurobehavioral features) at the time of admission and discharge.

Rehabilitation helps to reduce both types of impairments by the time of discharge.
• Demonstrated that those with a TBI scoring in the severe range of impairment demonstrated improvement within a structured multidisciplinary rehabilitation program event a year+ post-injury.

• Correlation analysis also revealed that behavior, cognition, and social skills were highly related to one another, thereby reinforcing the idea of comprehensive treatment rather than single deficit care. **Behavior is multifaceted and influenced by cognitive processes that impacts participation in the real world.**

• Neurobehavioral conditions can lengthen recovery by 2-3xs in a post-hospital model of care.

• Time significantly impacts outcome during the initial six months, but does not impact outcome beyond that point. Therefore, “**time will not heal all wounds.**”
• Neurobehavioral Disorders – 2022 research

• An estimated 11-34% of patients remain with persistent agitated behaviors after discharge from inpatient rehabilitation programs.

• Neurobehavioral disorders after acquired brain injury represent significant impairments for patients including poor impulse dyscontrol, explosive outbursts, verbal and physical aggression, poor planning, poor judgment, and poor self-awareness. These are chronic conditions that without structure and rehabilitation will become habit forming needing longer rehab and medication.

• The current study was focused on comparing patients that received comprehensive neurobehavioral treatment vs. those receiving Neurorehabilitation. Also, a clinical control group was used to account for the residential milieu effects.
### Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Neurorehabilitation</th>
<th>Neurobehavioral</th>
<th>Supported Living</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Size</strong></td>
<td>n = 261</td>
<td>N = 81</td>
<td>N = 95</td>
</tr>
<tr>
<td><strong>Mean Age</strong></td>
<td>40.5 (18 – 81 years)</td>
<td>37.9 (19 – 67 years)</td>
<td>44.5 (19 – 77 years)</td>
</tr>
<tr>
<td><strong>Mean LOS</strong></td>
<td>240 days (30 – 2051 days)</td>
<td>391 days (35 – 2567 days)</td>
<td>496 days (32 – 2988 days)</td>
</tr>
<tr>
<td><strong>Mean Chronicity</strong></td>
<td>655 days (243 – 1830 days)</td>
<td>805 days (255 – 1827 days)</td>
<td>741 days (247 – 1807 days)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>Males 216 (77%) Females 45 (23%)</td>
<td>Males 61 (83%) Females 20 (17%)</td>
<td>Males 75 (79%) Females 20 (21%)</td>
</tr>
<tr>
<td><strong>Diagnoses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anoxia/hypoxia</td>
<td>10 (4%)</td>
<td>3 (4%)</td>
<td>10 (11%)</td>
</tr>
<tr>
<td>CVA</td>
<td>18 (7%)</td>
<td>6 (7%)</td>
<td>13 (14%)</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>4 (1.5%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>TBI</td>
<td>216 (83%)</td>
<td>69 (85%)</td>
<td>70 (74%)</td>
</tr>
<tr>
<td>Tumor</td>
<td>4 (1.5%)</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Other neurological</td>
<td>9 (3%)</td>
<td>2 (3%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td></td>
<td>Mean difference</td>
<td>Std. Error Mean</td>
<td>Lower</td>
</tr>
<tr>
<td>---------------------</td>
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</tr>
<tr>
<td><strong>Neurorehabilitation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel Problem</td>
<td>0.39</td>
<td>0.052</td>
<td>0.289</td>
</tr>
<tr>
<td>Irritability</td>
<td>0.68</td>
<td>0.062</td>
<td>0.576</td>
</tr>
<tr>
<td>Inappropriate Social</td>
<td>0.44</td>
<td>0.064</td>
<td>0.310</td>
</tr>
<tr>
<td>Impaired Awareness</td>
<td>0.54</td>
<td>0.060</td>
<td>0.422</td>
</tr>
<tr>
<td><strong>Neurobehavioral</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel Problem</td>
<td>0.54</td>
<td>0.081</td>
<td>0.383</td>
</tr>
<tr>
<td>Irritability</td>
<td>0.56</td>
<td>0.117</td>
<td>0.324</td>
</tr>
<tr>
<td>Inappropriate Social</td>
<td>0.31</td>
<td>0.115</td>
<td>0.080</td>
</tr>
<tr>
<td>Impaired Awareness</td>
<td>0.52</td>
<td>0.107</td>
<td>0.306</td>
</tr>
<tr>
<td><strong>Supported Living</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel Problem</td>
<td>0.33</td>
<td>0.105</td>
<td>0.117</td>
</tr>
<tr>
<td>Irritability</td>
<td>0.51</td>
<td>0.115</td>
<td>0.277</td>
</tr>
<tr>
<td>Inappropriate Social</td>
<td>0.33</td>
<td>0.120</td>
<td>0.088</td>
</tr>
<tr>
<td>Impaired Awareness</td>
<td>0.24</td>
<td>0.125</td>
<td>-0.006</td>
</tr>
</tbody>
</table>
The three groups were closely matched at the time of admission. In order to be included in the study, each subject had to be rated at a 3 or 4 within the Irritability / Agitation item since the focus of this research was on behavioral impact with outcomes. By equalizing the groups on the behavioral measure, and by subjects living within the same facility and daily structure, this may have been sufficient to reduce observable differences. In addition, the three groups were chronically impaired, and prior research has shown that chronicity has an impact on outcomes.

Each of the groups was within a different program type, which focused on different aspects of rehabilitation for reduced disability.

- Although the Neurorehabilitation group was primarily focused on cognitive and physical functioning, the structure of the program also helped to reduce the behavioral impairments that would prevent discharge to the community.
- The Neurobehavioral programs focused on high intensity behaviors that may vary in frequency, but cause impairment with societal participation. Therefore, the emphasis was on the targeted behaviors and problem solving, and less emphasis was placed on improving physical and cognitive functions since these skill areas were relatively stable. Both programs offer behavioral modification as part of the structure and therefore may appreciate the same gains by the time of discharge.

The Supported Living group provided an unexpected finding, namely, a reduction in the neurobehavioral outcome measures. The difference between this group and the other two groups was that supported living’s focus was on medical stability and community integration rather than rehabilitation. It seems that the secondary effect was the positive impact on behavior by providing a base daily structure that also shaped the behaviors of the subjects.

Overall, all three groups improved from admission to discharge using both remediation and compensatory strategy development. Effect sizes were statistically and clinically significant for Neurobehavioral and Neurorehabilitation groups for reduction of irritability/agitation, and problem solving though the Neurobehavioral group realized greater effect with problem solving.
Summary

Behavioral Disorders Exist – Neurobehavioral Syndrome.

Behavioral Disorders can be disruptive to most things.

Behavioral Disorders are resistant to treatment at first.

Behavioral Disorders demonstrate a problem starting with the brain.

Behavioral Disorders are due to multiple causes – not just one.

Behavior can change!
Guidelines to reduce behavior impairment

*Person-centered:* individual should be included in identification and design of the treatment plan.

*Supportive:* plan’s design should make it very likely that the individual will succeed (especially in the early stages). Assess all of their needs as noted above.

*Simplicity:* plan should be easy for staff and individual to understand.

*Consistency:* plan must be implemented as consistently as possible.

Education of staff, patient, and family about the goals and objectives. Make sure that resources are considered as part of the discharge process.

*Flexibility:* plan must be flexible enough to adapt to changes in the individual.

*Positive:* staff should discuss the person’s successes.
Questions

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Addendum

Behavioral Strategies / Interventions
&
Environmental Control
Some think...

It is important to look at the positives and negatives of behavior.

**Positive Behaviors often have no risk, so we tend to gloss over these…**

1. Social courtesy – consideration to others
2. Social Skills Use
3. Problem Solving
4. Appropriate requesting
5. Self Calming
6. Safety Awareness
7. Acceptance of Feedback

In brain injury – the goal is to use these positive behaviors to replace negative behaviors. Focus on the positive and ignore the negative.
Some think…

Negative Behaviors often have RISK – that is why we tend to pay greater attention to these behaviors.

1. Verbal Outbursts
2. Verbal Aggression
3. Physical Aggression
4. Inappropriate Sexual Behaviors
5. Elopements – leaving without permission or without someone knowing where you are
6. Impulsivity
7. Self-Harm

Behaviors in brain injury mostly fall into one of the categories above. The behaviors are the direct result of the injury type and location of injury in the brain.
Both the positive and negative behaviors should be measured so that proper intervention can be determined.

Behavior plans help to determine the relative frequency and intensity of the behaviors.

*Behavior plans help to determine if other things, such as the environment, is contributing to the behavior being triggered.*
Management of Behaviors

Which behavior is “normal”?

You can’t make a behavior occur if it is not in the natural sequence of behaviors for that individual.
Guidelines to Reduce Behavior

• Remember 3 Letters…..

• A – Antecedents (what happened before the behavior was shown)

• B – Behavior(s) (define the behavior)
  • What is the behavior
  • Frequency
  • Intensity

• C – Consequence(s) (what happened after the behavior occurred)
  • Reinforcement
  • Punishment
  • Extinction
Bibliography – Neurobehavioral conditions and treatment

• Bechara, Damasio & Damasio, 2000; Cerebral Cortex)
• Center for Disease Control (2013). Health Statistics.
• Horn & Lewis, 2013
• Horn, Lewis, Russell, 2016
• Kreutzer, Marwitz & Kepler, 1992
• Lewis & Horn, 2013 and 2014
• Livingston, 1990, Romano, 1974
• West (2011; Neurorehabilitation)
• Wikipedia, 2013
Bibliography - Strategies

• Bechara, Damasio & Damasio, 2000; Cerebral Cortex)
• Center for Disease Control (2013). Health Statistics.
• Horn & Lewis, 2013
• Kreutzer, Marwitz & Kepler, 1992
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• West (2011; Neurorehabilitation)
• Wikipedia, 2013
Fann J, Bombardier C, Temkin N, Esselman P, Warms C, Barber J, Dikmen S. Sertraline for major depression during the year following traumatic brain injury: A Randomized Controlled Trial. J Head Trauma Rehabil, 2017 May 17. [Epub ahead of print]
Bibliography – Psychopharmacology in TBI (continued)


Bibliography – Psychopharmacology in TBI (continued)


