Traumatic Brain Injury and Sensory Stimulation: Multidisciplinary Impact and Benefits

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Focus on assessment, therapy, and support for clients and families.

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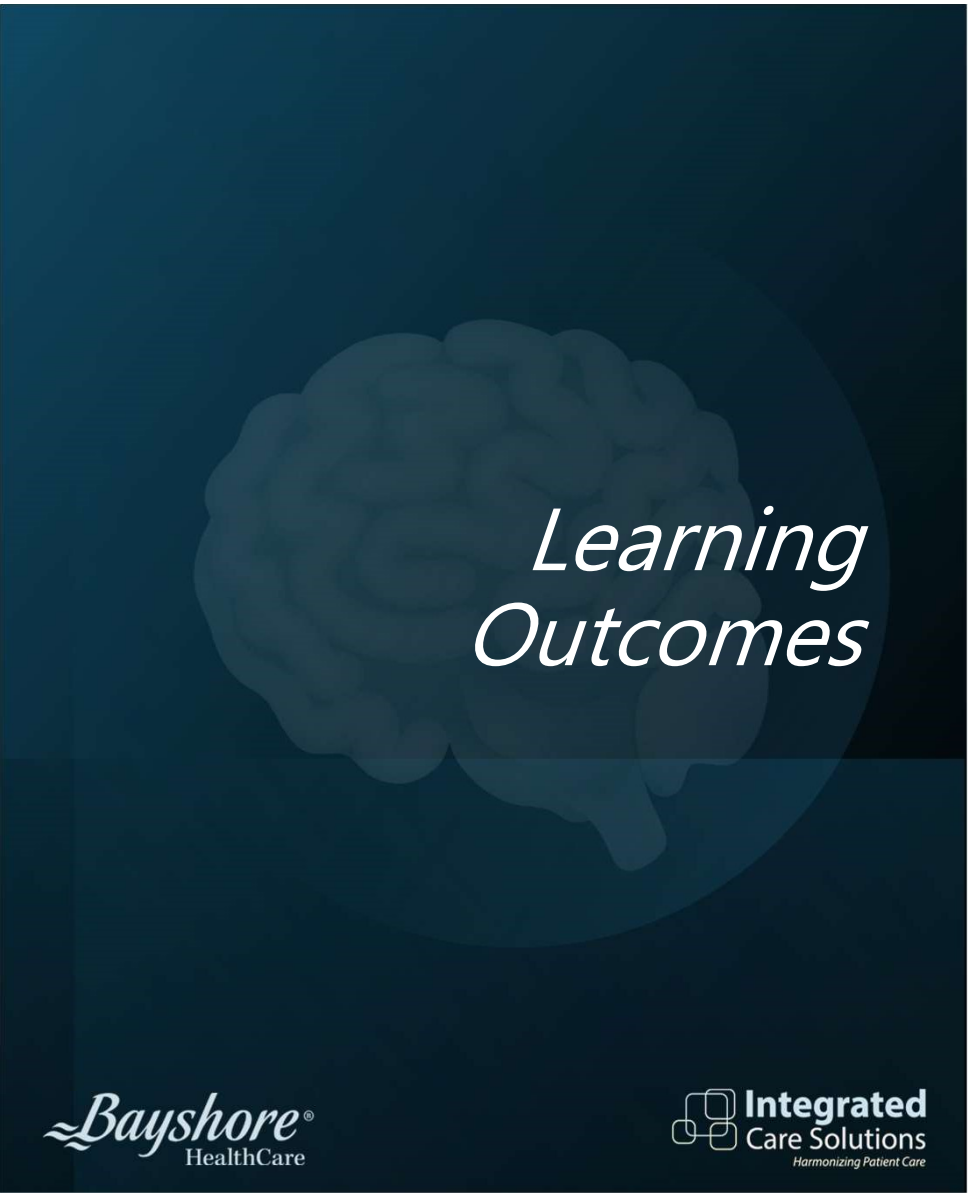


- Identify the characteristics of minimally conscious states.
- Explain the distinctions between coma and disorders of consciousness.
- Select and apply appropriate assessment tools and resources.
- Analyze the outcomes of sensory stimulation programs on patient recovery.
- Design tailored intervention strategies for multidisciplinary teams.
- Evaluate program effectiveness using clinical data.
- Develop a multidisciplinary toolkit for supporting minimally conscious clients.

Bayshore® ICS-NRIO: Who We Are and What We Do

ICS NRIO provides private, multi-disciplinary *Brain Injury Rehabilitation.*

Bayshore® ICS-NRIO: Who We Are and What We Do

NRIO Programs include:

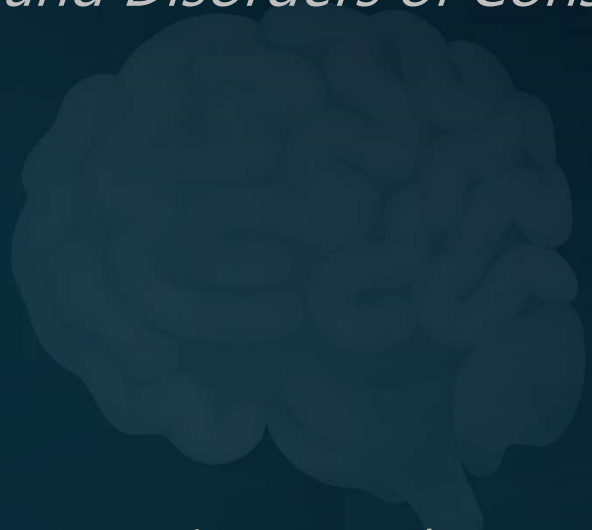
- 24/7 Supportive residential rehab
- Supported Living Apartments
- Dual Diagnosis
- Adult Day Program
- Clinic and outreach services
- School resources services (teaching, tutoring and transition support)
- Sensory stimulation/slow-to-recover programs in hospitals, community and home

Bayshore® ICS-NRIO: Who We Are and What We Do

Services include:

- Manager and Care Coordination
- OT, PT, SLP
- Behaviour Therapy
- Addictions Counselling
- Art and Music Therapy
- Neuropsychology
- Neuropsychiatry
- Transition Planning
- Independent Living Assessments

Coma and Disorders of Consciousness



Definition of Coma:

A prolonged state of unconsciousness due to severe injury or illness.

Coma and Disorders of Consciousness

Consciousness Components

Wakefulness

Controlled by the brainstem, regulates eye opening and vital functions.

Awareness

Involves self-perception and environment, controlled by higher brain structures.

Locked-In Syndrome

- Paralysis with intact awareness.
- Communication through eye movement or blinking.

Coma and Disorders of Consciousness

Common Causes of Coma

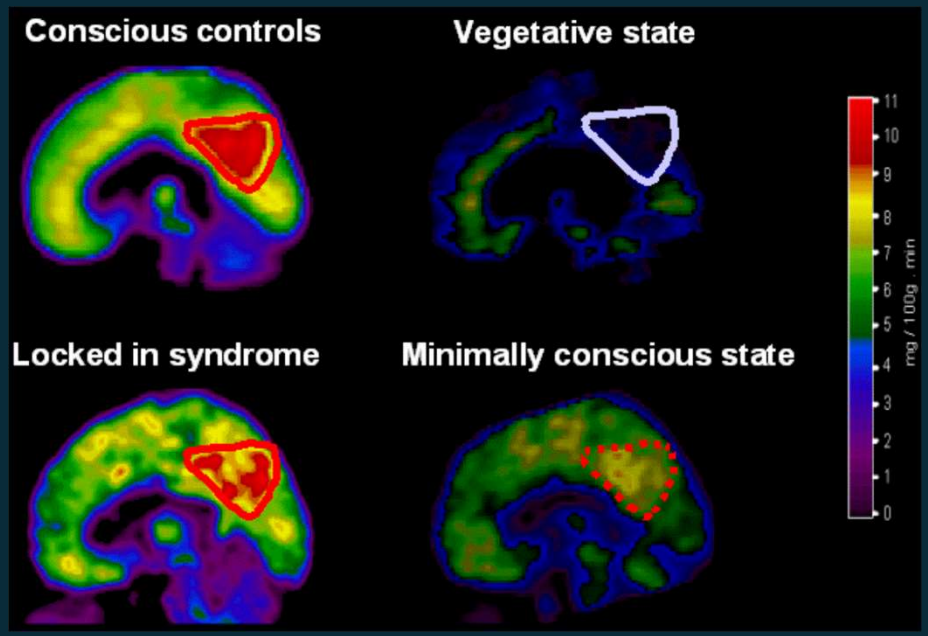
- Severe head trauma
- Anoxic brain injury
- Stroke or cardiac event
- Infection or toxins
- Blood sugar extremes

Brain Metabolism Across Levels of Consciousness

Resting State Metabolism:

- Brain metabolism decreases with the level of consciousness.
- The medial posterior cortex (precuneus and posterior cingulate cortex) is key to consciousness.

Note: Locked-in syndrome shows no significant decrease in metabolism.



Colour Key:

- **Red/Orange**: High metabolic activity (conscious state).
- **Yellow/Green**: Moderate activity (minimally conscious state).
- **Blue/Purple**: Low activity (vegetative state).

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The Complexity of Determining Consciousness

DAILY NEWS

Lorem ipsum

Kentucky man declared brain dead 'woke up' during organ harvesting.

Officials in the US's organ-procurement system insist there are safeguards in place to prevent such episodes.
Photograph: Kinga Krzeminska/Getty Images

Up to 40% of patients are misdiagnosed as "vegetative" when they are actually "minimally conscious" (Schnakers C., Vanhaudenhuyse A., Giacino J., et al. (2009)

- Study Insight: 25% of unresponsive patients show covert awareness.
- Detection: Brain imaging (fMRI) reveals hidden responses.
- Challenge: Limited access to advanced diagnostic tools.
- Impact: Many patients may be underestimated in their potential for recovery.

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US man wakes from 19-year coma

A man from the US state of Arkansas has regained consciousness after spending 19 years in a coma.

Terry Wallis, 39, had been at the centre of an accident in July 1984 when a car he was travelling in plunged into a creek.

Terry Wallis: Weekend trips away kept his brain working

The driver of the vehicle, Mr Wallis' friend, died.

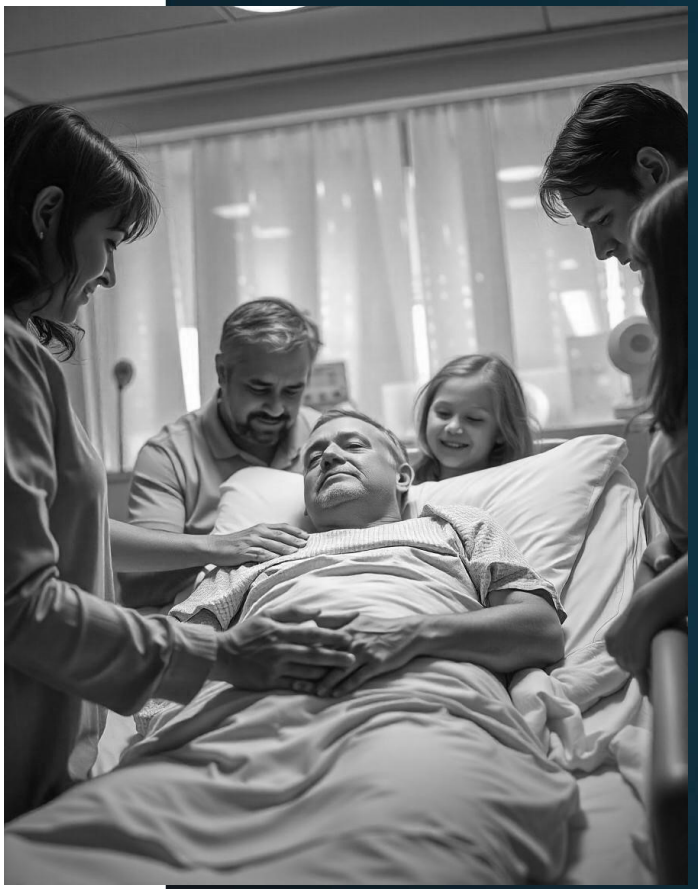
Mr Wallis was discovered by rescuers a day later, but was comatose.

He has many historic events to catch up with, including the election of his state governor, Bill Clinton, to the presidency of the United States, his time in office and his handover to George W Bush.

He startled his family by speaking suddenly almost a month ago.

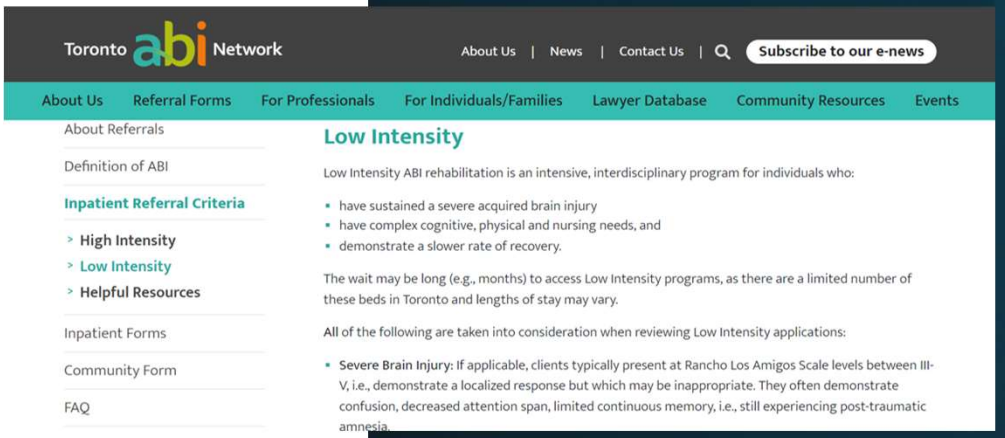
Family Testimonials

"I want to express my gratitude to Vox Neuro and Dr. John Connolly, whose team performed the critical testing that opened doors to rehabilitation facilities for my husband… The testing confirmed he was cognitively aware… When we finally got him into a facility, the staff asked us why he hadn't been admitted sooner.
This question haunts us: why didn't we get him the help he needed sooner?"—Anonymous



What Does Treatment Currently Look Like?

- Low-Intensity ABI Rehabilitation
- Offered for individuals with severe acquired brain injuries.
- Focus on clients with complex needs and slower recovery rates.
- Eligibility determined using the Rancho Los Amigos Scale.



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Rancho Los Amigos Scale & Rehabilitation Gaps

Level		Score and Interpretation
Level I	No Response	• Require total assistance • No response to external stimuli
Level II	Generalized Response	• Require total assistance • Respond inconsistently and non-purposefully to external stimuli • Responses are often the same regardless of the stimulus applied
Level III	Localized Response	• Require total assistance • Respond inconsistently and non-purposefully to external stimuli • Responses are directly related to the stimulus
Level IV	Confused, Agitated	• Require Maximal Assistance • In a hyperactive state with bizarre and non-purposeful behaviour • Demonstrate agitated behaviour that originates more from internal confusion than the external environment
Level V	Confused, Inappropriate, Non-Agitated	• Require Maximal Assistance • Increased consistency with responding to simple commands, their responses are non-purposeful and random to more complex commands • Behaviour and verbalization are often inappropriate, and appear confused and often confabulates
Level VI	Confused, Appropriate	• Require Moderate Assistance • Able to follow simple commands consistently • Demonstrate an increased awareness of self, situation, and their environment but are unaware of any specific impairments and safety concerns

Rancho Los Amigos Scale Overview:

- Levels 1-2: Minimal response to stimuli.
- Level 3+: Qualify for active hospital rehabilitation.
- Many clients at NRIO function at Levels 2-3, bridging the gap for those who don't qualify for hospital rehab.

Family Testimonials

"After 'M' came out of his coma and was on the mend, I brought him his guitar… The people in ICU were amazed that he could do that. In the months that followed, we kept petitioning the Social Worker… Everyone turned 'M' down because they deemed him to have no 'buildable memory'… My heart broke every time we received a no because I could see that he was slipping away…"

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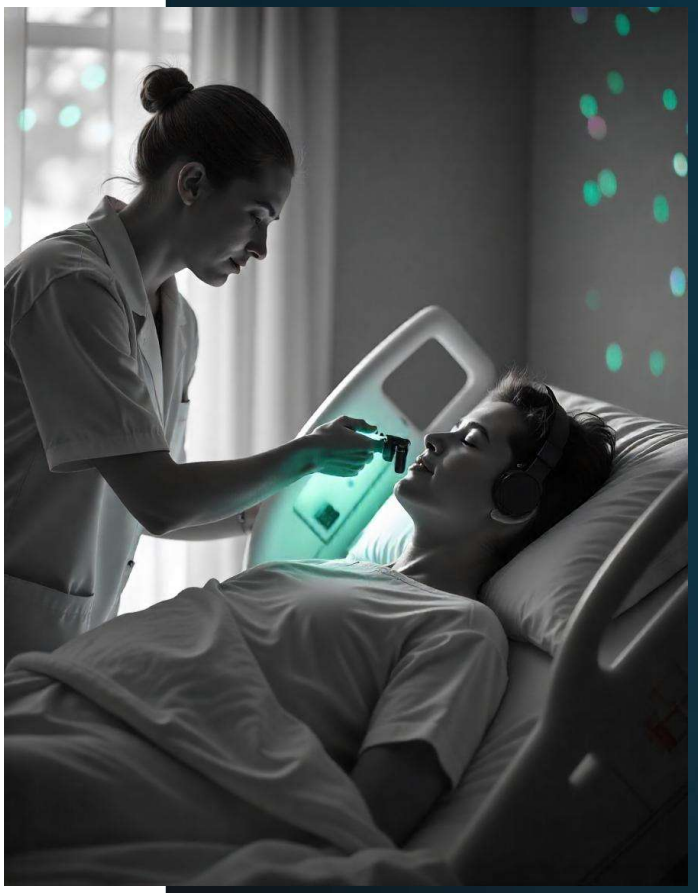
Effectiveness of Sensory Stimulation Programs



Positive Outcomes:

- Sensory stimulation showed immediate and long-term improvements in sensory functioning. (Pinto et al., 2022)
- Systematic review demonstrated increased GCS scores after multimodal stimulation compared to no intervention. (Alashram, 2021)
- 20/21 studies reported benefits for low- and higher-level sensory deficits post-stroke. (Tinga et al., 2016)

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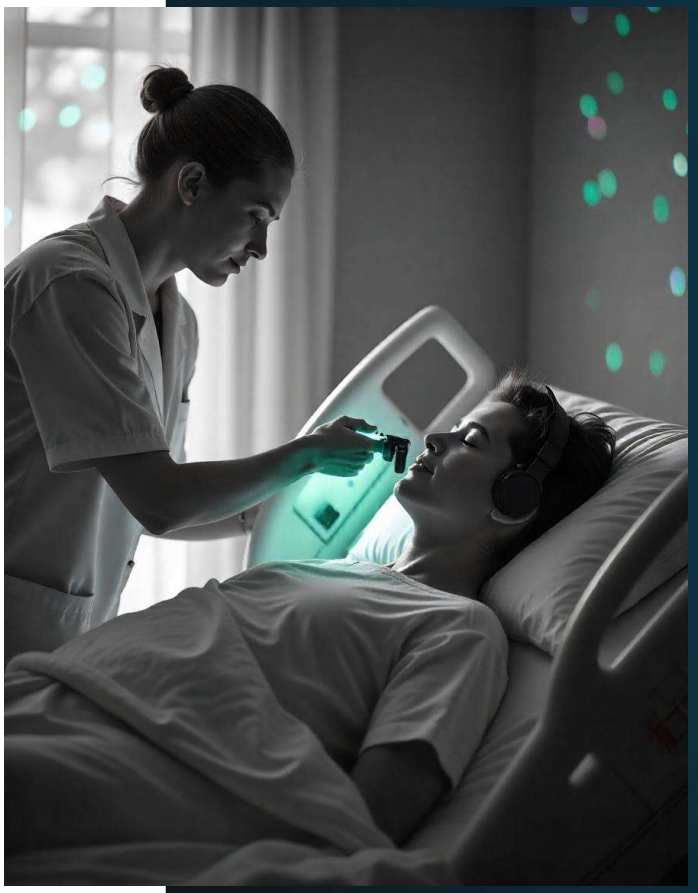
Effectiveness of Sensory Stimulation Programs

Evidence-Based Review Highlights (ERABI, 2018):

- Auditory sensory stimulation improves assessment measures but not Glasgow Outcome Scale scores.
- Multi-sensory stimulation shows limited impact on coma emergence/recovery post-ABI.
- Music therapy may enhance consciousness in coma patients post-ABI.
- Physiotherapy significantly improved motor (MAS) and cognitive (MMSE) scores in patients after 1–2 weeks in a coma.



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Methods and Tools

Assessment Tools:

- CRS-R (Coma Recovery Scale-Revised): Tracks cognitive recovery and responsiveness.
- CNCS (Coma Near Coma Scale): Measures small changes in awareness.
- DOC-25 (Disorders of Consciousness Scale): Evaluates functional and cognitive changes.
- Patient/Family questionnaires for personalized programs

Program Components:

- Personalized sensory stimulation kits: (Cost of $100 CAD)
- Multidisciplinary team: PT, OT, SLP, Rehab Therapists, Music/Art Therapists.
- Routine reassessment for program adjustment.
- Family input to ensure relevance and familiarity.

Program Delivery:

- Multidisciplinary involvement: PT, OT, SLP, and neuropsychology teams.

Methods and Tools

JFK Coma Recovery Scale

JFK COMA RECOVERY SCALE ©2004
Record Form

This form should only be used in association with the "CRS-R ADMINISTRATION AND SCORING GUIDELINES" which provide instructions for standardized administration of the scale.

Patient:	**Diagnosis:**									
Date of onset:	**Date of Admission:**									
Date										
Assessment	**1**		**2**		**3**		**4**		**5**	
AUDITORY FUNCTION SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
4 – Consistent Movement to Command▪										
3 – Reproducible Movement to Command▪										
2 – Localization to Sound										
1 – Auditory Startle										
0 – None										
VISUAL FUNCTION SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
5 – Object Recognition▪										
4 – Object localization: Reaching*										
3 – Visual Pursuit*										
2 – Fixation*										
1 – Visual Startle										
0 – None										
MOTOR FUNCTION SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
6 – Functional Object Use†										
5 – Automatic Motor Response*										
4 – Object Manipulation*										
3 – Localisation to Noxious Stimulation*										
2 – Flexion Withdrawal										
1 – Abnormal Posturing										
0 – None										
OROMOTOR/VERBAL FUNCTION SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
3 – Intelligible Verbalization▪										
2 – Vocalization/Oral Movement										
1 – Oral Reflexive Movement										
0 – None										
COMMUNICATION SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
2 – Functional: Accurate†										
1 – Non-functional: Intentional▪										
0 – None										
AROUSAL SCALE	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**	**#**	**TCC**
3 – Attention										
2 – Eye Opening w/o Stimulation										
1 – Eye Opening with Stimulation										
0 – Unarousable										
TOTAL SCORE										

* Denotes Minimally Conscious State Minus (MCS-)
▪ Denotes Minimally Conscious State Plus (MCS+)
† Denotes emergence from Minimally Conscious State (eMCS)
TCC Test Completion Code

Methods and Tools

Sensory Stimulation Kit

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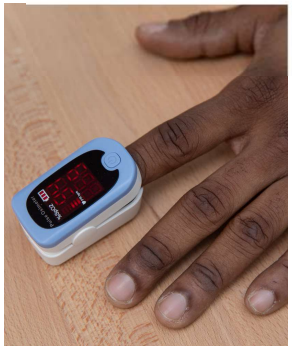
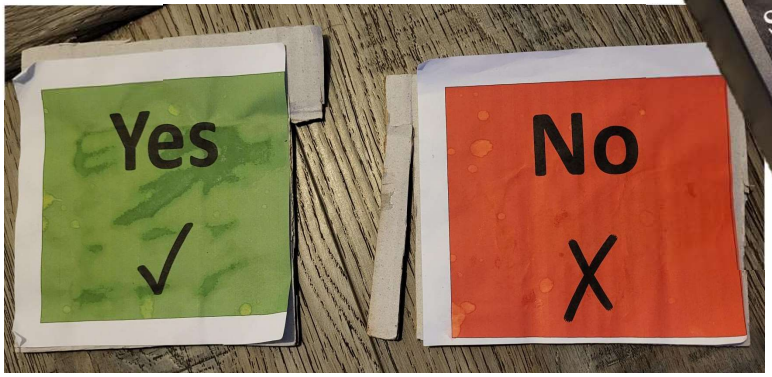




Considerations

Timeframe:

- Early intervention yields better outcomes (Gruner & Terhaag, 2000).
- Short, frequent sessions with rest breaks (Oh & Seo, 2003).

Target Population:

- GCS: 3–8; Rancho: 1–3.

Safety:

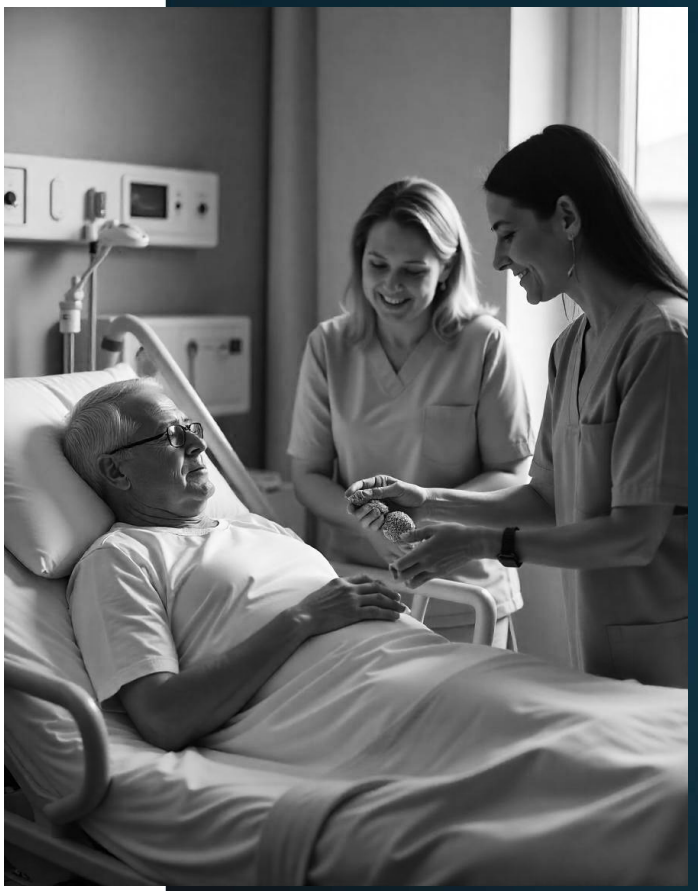
- Medically stable: Monitor vital signs, avoid sensory overload, and manage ICP concerns.

Pre-Injury Functioning:

- Glasses, hearing aids, etc.
- Culture, language, occupations, etc.

Tracking Progress

- Clear, consistent data collection
- MS Forms
- Focus on function and observable behaviour
- Track new responses



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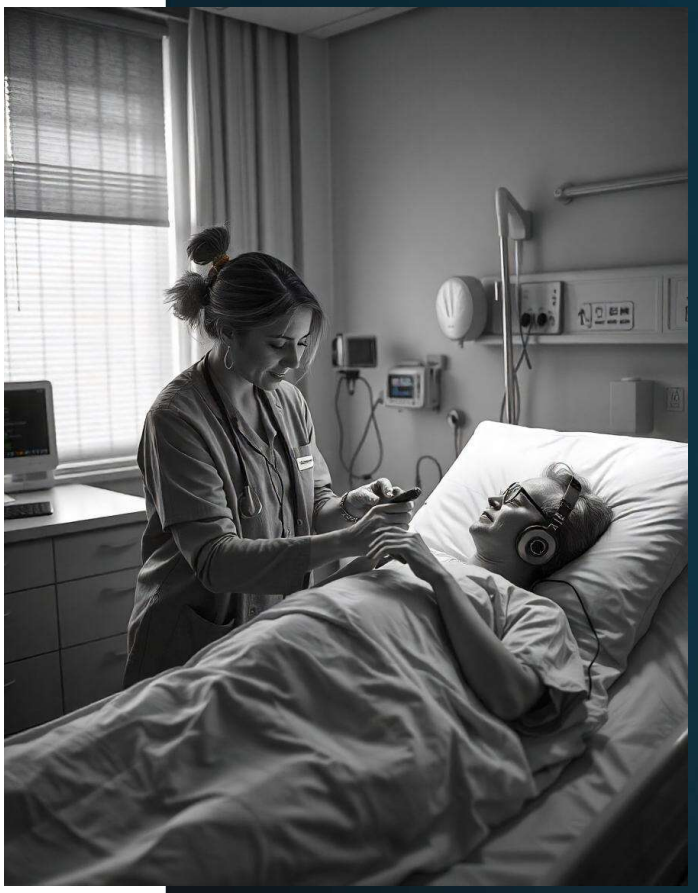
Sensory Stimulation Guidelines and Modalities

General Guidelines:

- Check-in with caregivers
- Prepare the person for stimulation
- Start with calming stimuli; progress to excitatory.
- Use one or two senses at a time.
- Allow 1–2 minutes for response and explain stimuli to the patient.
- Control the environment: minimize distractions and ensure patient comfort.
- Allow time for responses between stimuli.



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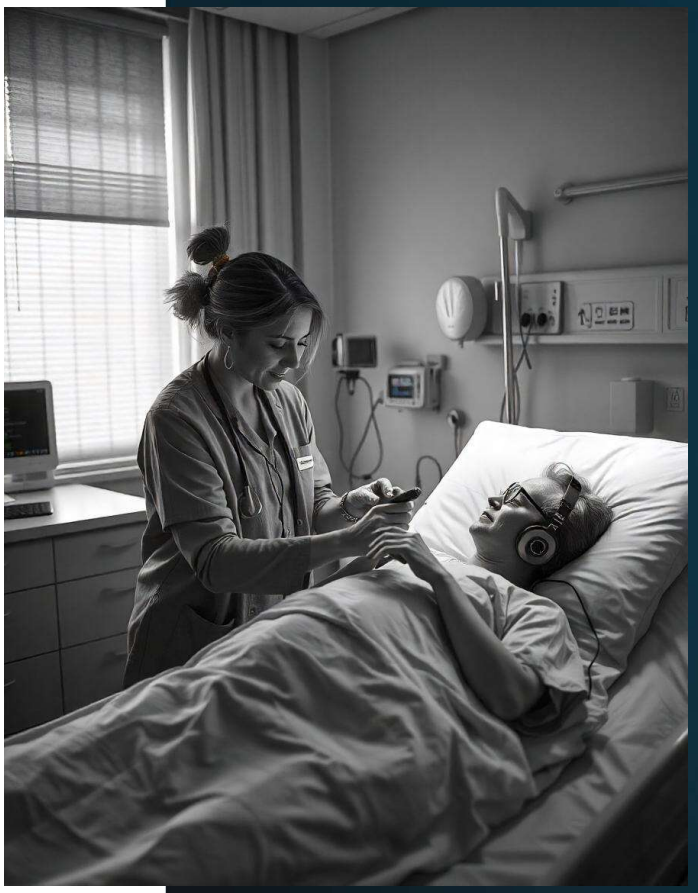
Sensory Stimulation Guidelines and Modalities

Key Sensory Modalities:

- Visual: Photos, bright objects.
- Auditory: Music, familiar voices.
- Tactile: Textured objects, temperature changes.
- Proprioceptive/Motor: Weight-bearing, assisted movements.
- Olfactory/Gustatory: Familiar scents, taste swabs.



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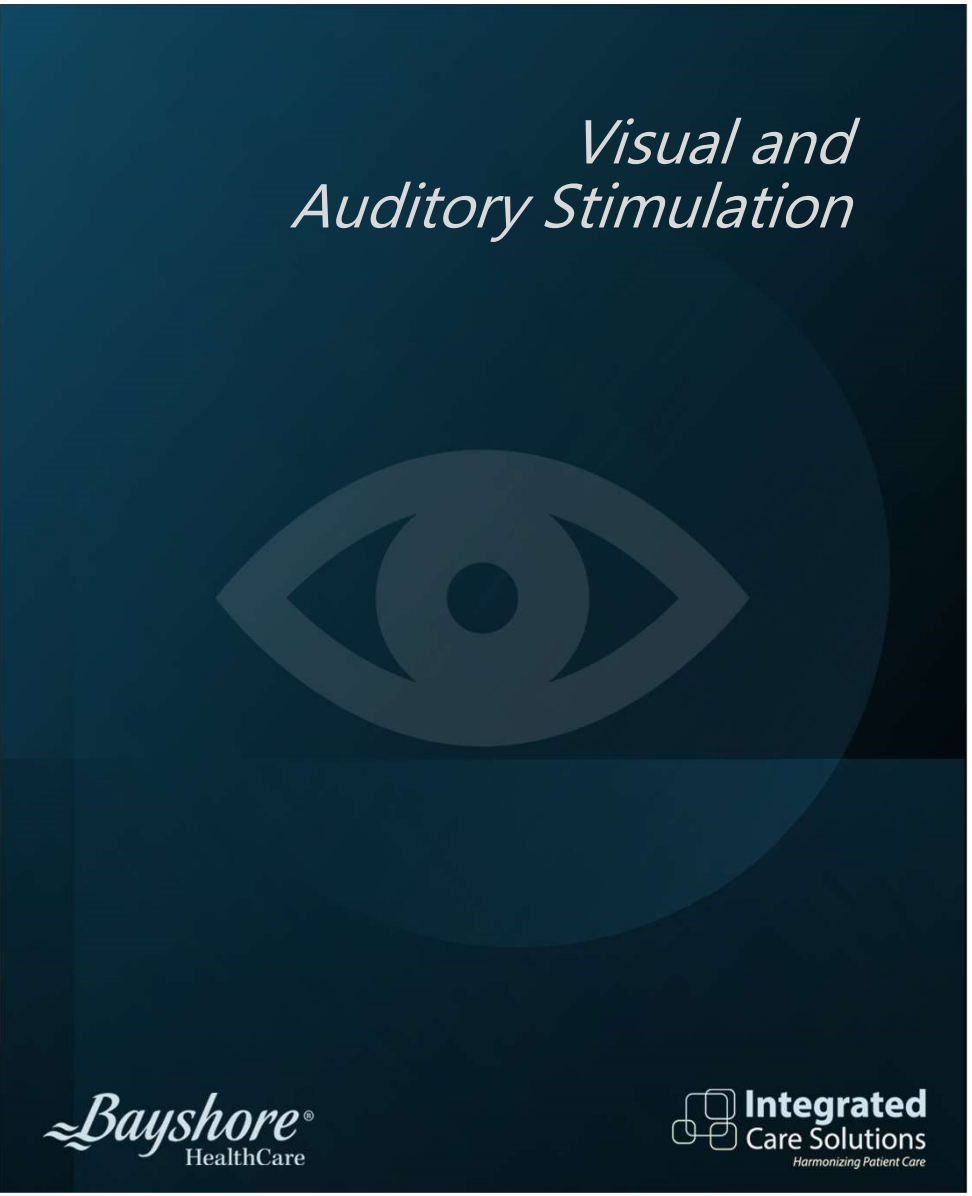


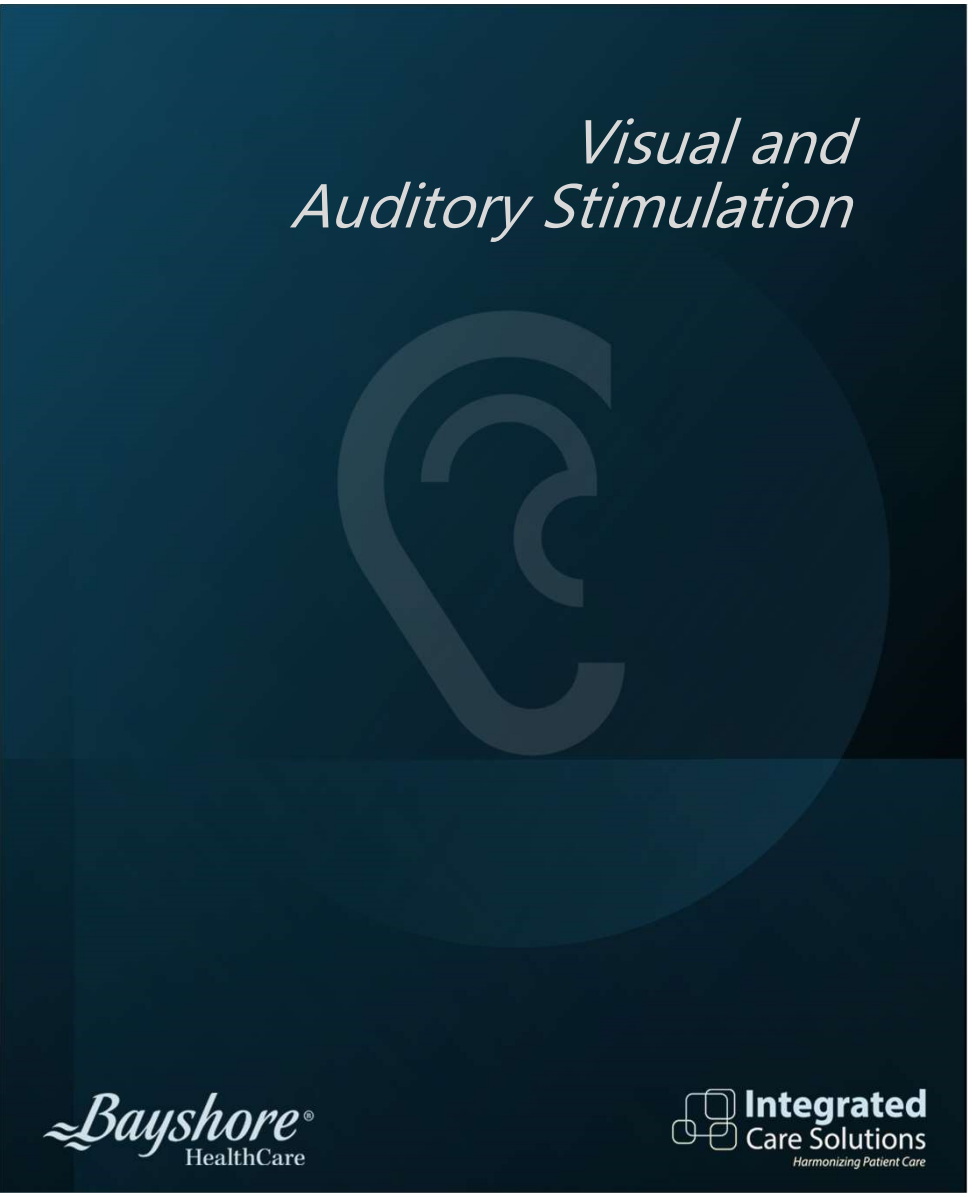
Visual Stimulation

Tools:
Family photos, mirrors, bright objects, and videos.

SMART Goals:
Enhance tracking, recognition of objects, and emotional responses.

Approach:
Begin with large, brightly coloured objects; gradually introduce more familiar or detailed visuals.

Responsiveness:
Increased eye-opening, fixation, tracking, and recognition.



Auditory Stimulation

Tools:
Familiar voices, favourite music, and environmental sounds (e.g., birdsong).

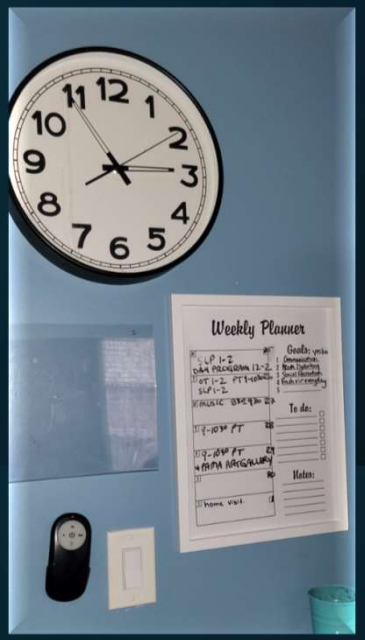
SMART Goals:
Improve response to auditory cues, orient to sounds, and encourage emotional engagement.

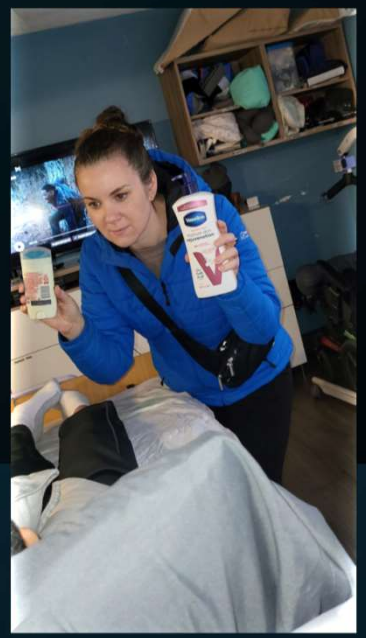
Responsiveness:
Reflexive blinking, pupil constriction/dilation, orientation to sound, emotional responses.

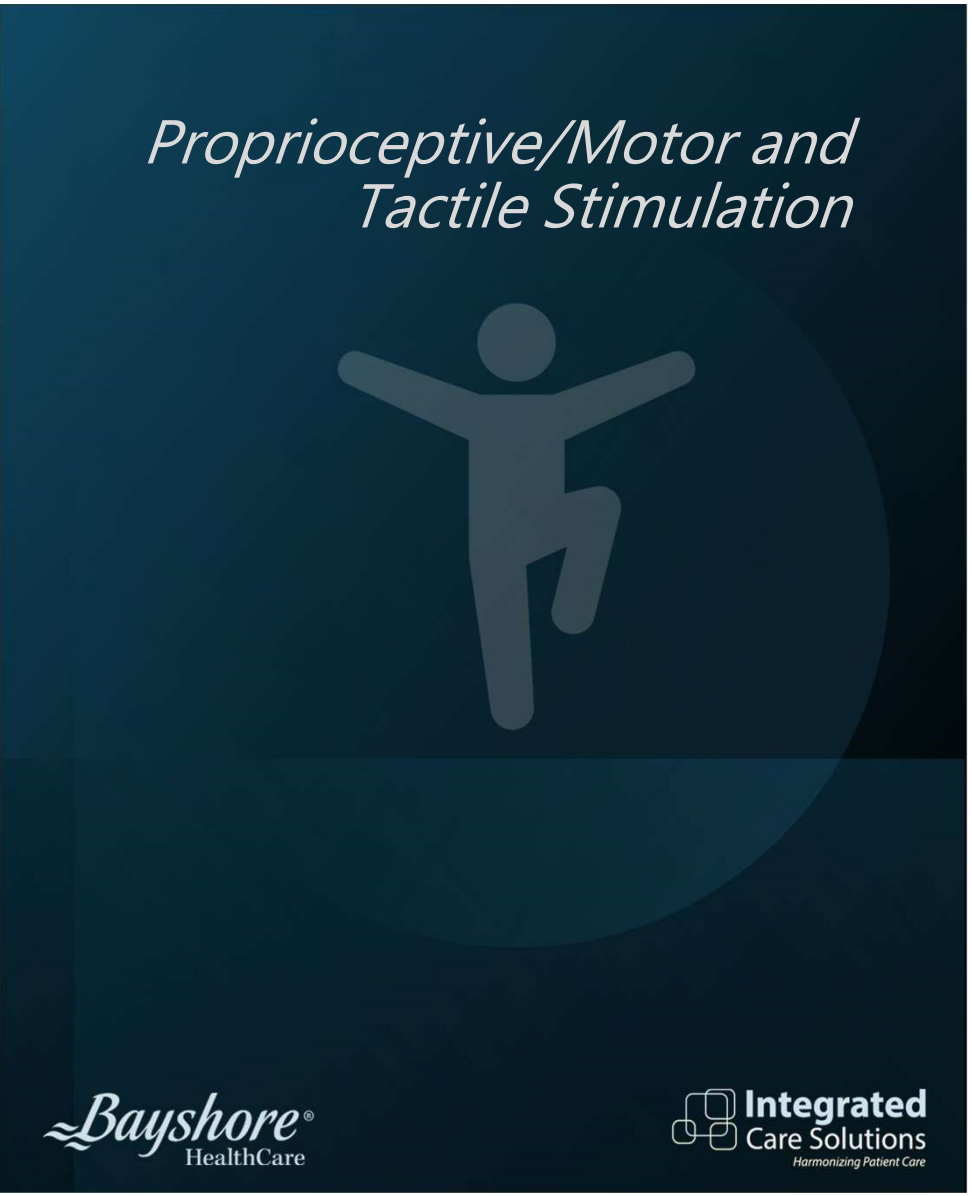
Considerations:
Hearing impairments, preinjury hearing aid use, tinnitus, ambient noise, and short, slow, consistent commands.

Visual and Auditory Stimulation

Sensory Stimulation Testing







Proprioceptive/Motor

Activities:
PROM/AROM, weight-bearing, functional movements with familiar items.

Responsiveness:
Reflexive (posturing, yawning, sneezing), intentional (localized movement, facial expression changes, functional item use).

SMART Goals:
Thumbs-up on 3/4 trials within 20 seconds over 4 weeks.

Considerations: Tone/spasticity, weight-bearing restrictions, monitor vitals.

Proprioceptive/Motor and Tactile Stimulation

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Tactile Stimulation

Materials:
Textures, temperatures, familiar objects.

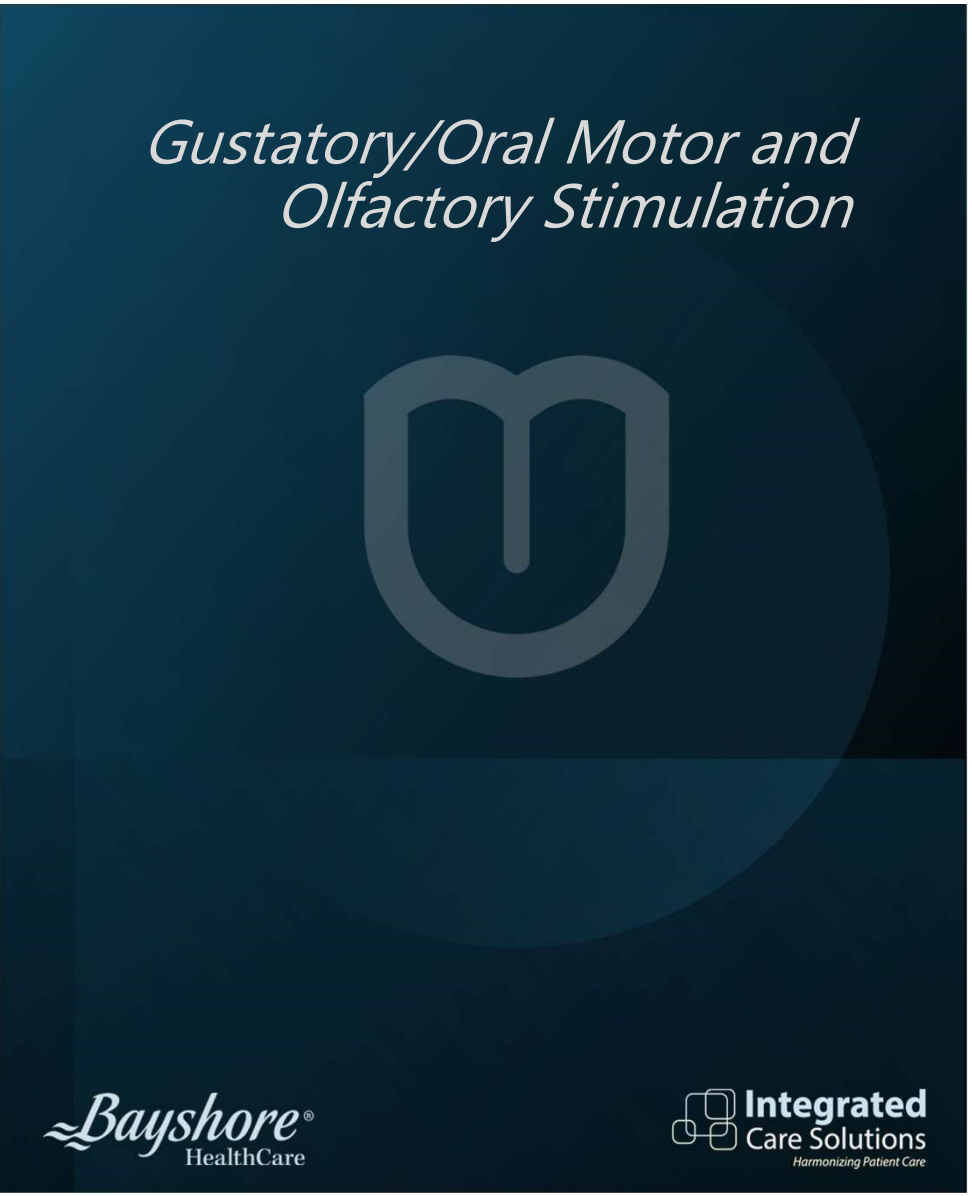
SMART Goals:
Respond Yes/No about stimulus or withdraw stimulated limb on 3/4 trials within 4 weeks.

Responsiveness:
Reflexive (eye/head orientation, limb flexion/extension), intentional (grimace/smile, limb withdrawal, answering stimulus-related questions).

Considerations:
Use calming or excitatory techniques; avoid feathers, sparkles, and flakey materials.

Proprioceptive/Motor and Tactile Stimulation

Sensory Stimulation Testing



Gustatory/Oral Motor

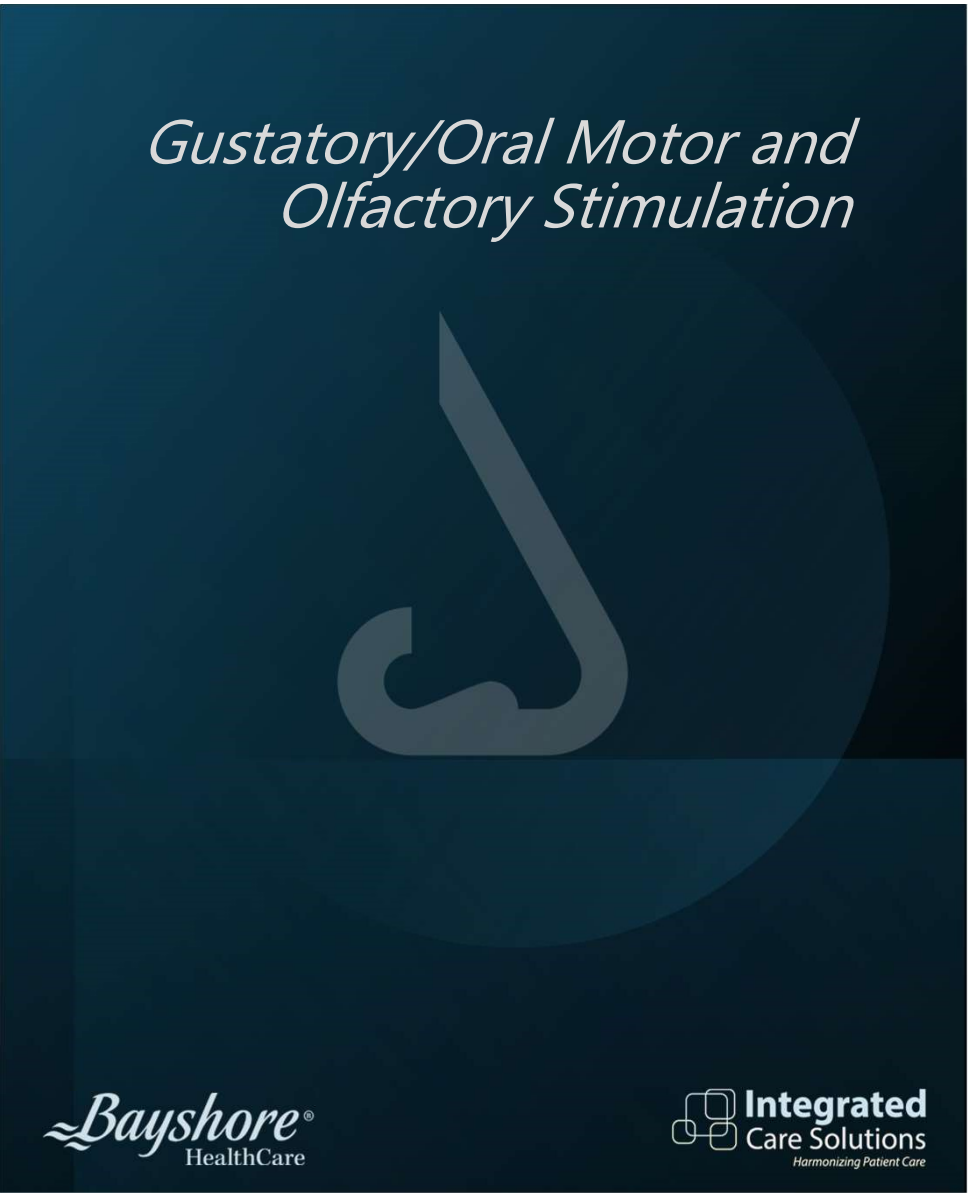
Materials:
Taste swabs, toothbrush, tongue depressor, whistles.

Responsiveness:
Reflexive (tongue pumping, salivation), intentional (tongue movement, open/close mouth).

SMART Goals:
Open mouth on 3/4 trials or identify 3/4 tastes using Yes/No cards.

Considerations:
Hygiene, jaw tightness, taste loss, cultural preferences.

Gustatory/Oral Motor and Olfactory Stimulation



Olfactory Stimulation

Materials:
Familiar (flowers, coffee) and new scents (onion, vinegar) and essential oils.

SMART Goals:
Sniff or identify 3/4 scents within 4 weeks using Yes/No cards.

Responsiveness:
Reflexive (grimace, smile), intentional (sniffing, head movement).

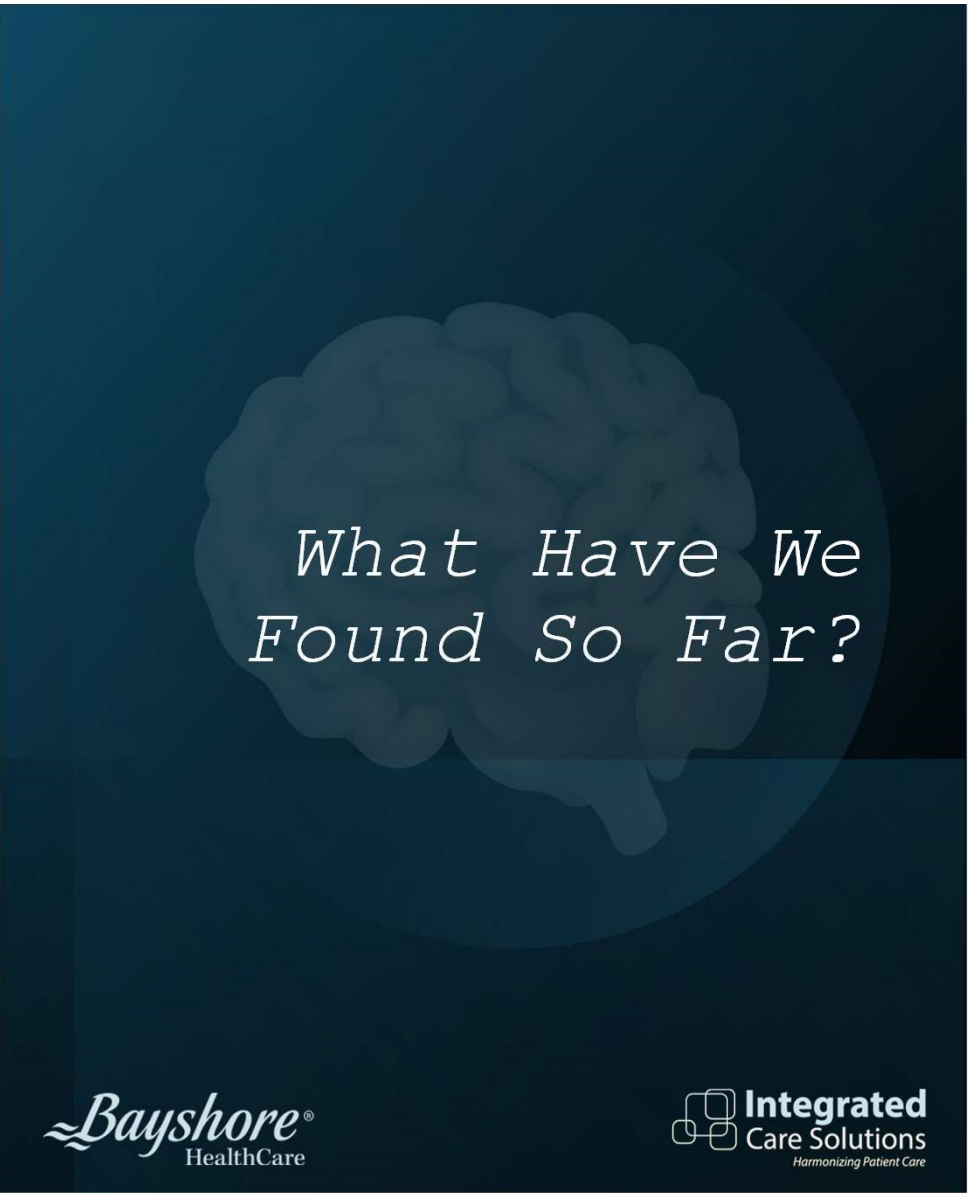
Considerations:
Hospital scent policies, cultural preferences.

Gustatory/Oral Motor and Olfactory Stimulation

Sensory Stimulation Testing

Functional Assessment Comparison Chart

CRC-R Scale	Evidence of UWS	Evidence of MCS
Auditory	Blinks to a sudden, loud sound	Opens mouth when instructed
Visual	Blinks when object comes close to eye	Follows a moving mirror with eyes
Motor	Pulls back hand/foot when pressure applied	Tries to grab an object placed on top of the hand
Oromotor	Clamping of jaws, chewing, yawning, closing mouth when toothbrush touches the mouth	At least 2 different words produced orally, written or using an alphabet board
Communication	No evidence of communication	Clear, consistent communication (e.g., head nod, thumbs up)
Arousal	Eye-opening with and without stimulation	Consistent eye-opening without stimulation maintains attention



Preferred Side or Limb: Clients often show better consistency with one side or limb.

Wakefulness Duration: Wakefulness improves over time (provided no health issues).

Optimal Session Length: 30–60 minutes works best; longer sessions need breaks.

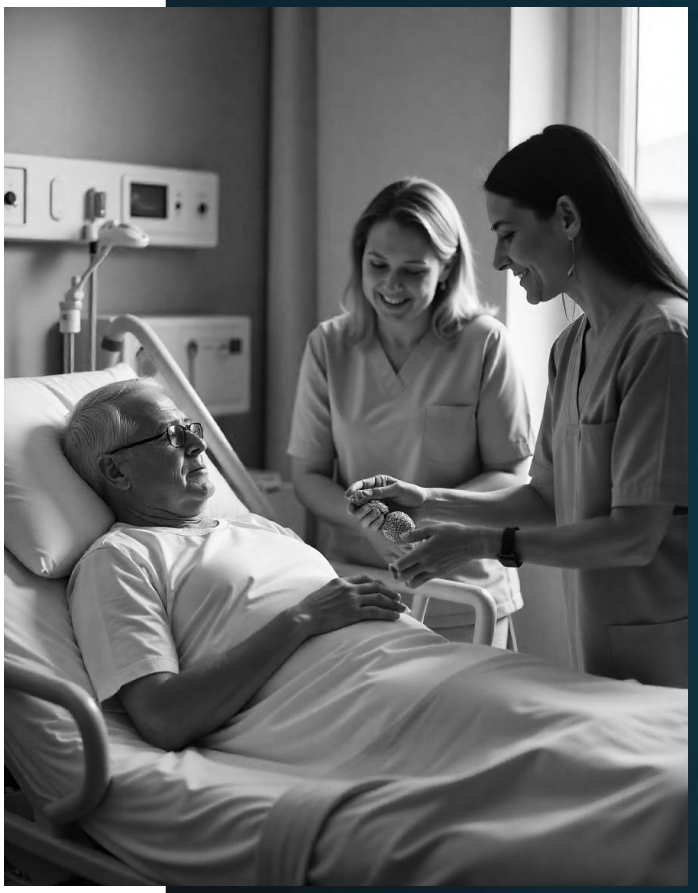
Specificity Matters: Greater specificity and consistency = better responsiveness.

Responsiveness to People: Clients respond differently to different people, even with the same cues.

Sensory Stimulation Example

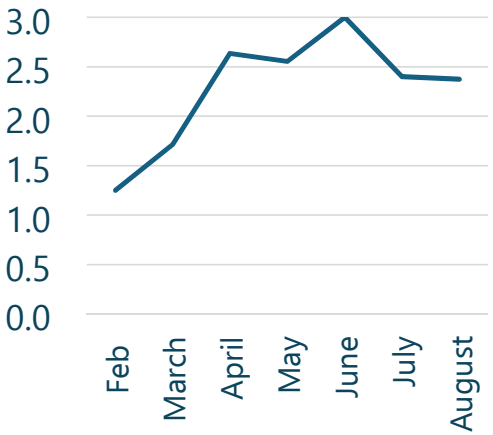
Tested various modalities:

- Open and closing hand
- Showing numbers
- Simple decision making

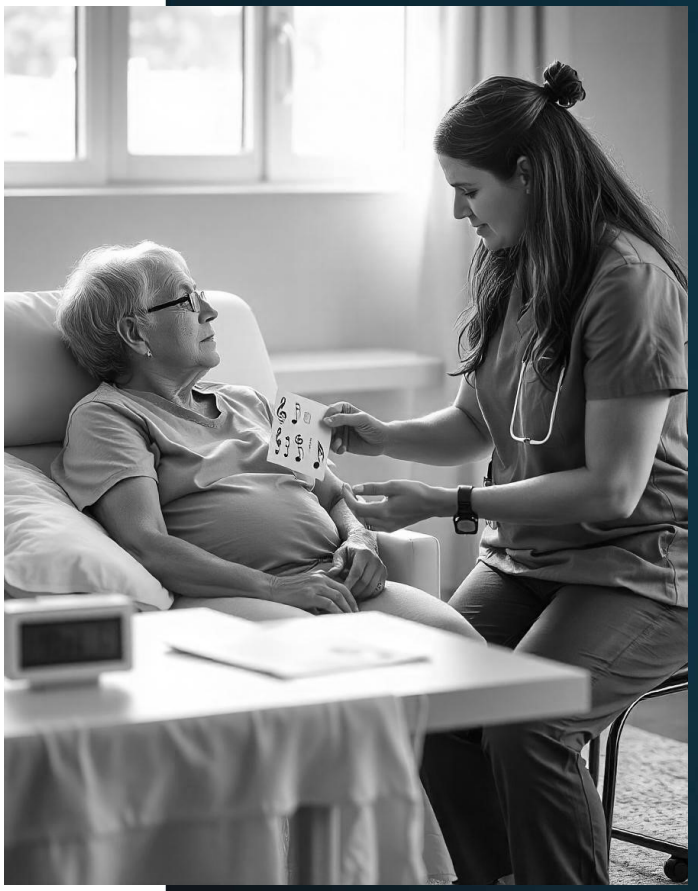


Effectiveness of Sensory Stimulation Programs

Making a Choice



- 3: Consistently selects the same music card.
- 2: Confirms choice with an eye blink after viewing different cards.
- 1: Views different cards but does not confirm with an eye blink.
- 0: No response observed.



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Making A Choice

Facilitating Choices for Personal Engagement

Make a Choice!

Clothing selection!

Provide contextual information:
"Today, the weather outside is ____."
Or "Today is your birthday, maybe you want to wear something special."

- **Step 1:** I have two shirts here, a ____ shirt and a _____ shirt (hold up the shirts so she can see).
- **Step 2:** Do you want to wear the ____ shirt? Blink once for "yes" and twice for "no". You may need to repeat the question and give extra time to respond (20 sec)
- **Step 3:** Provide feedback on her response. "It looks like you want to wear the ____ shirt because you blinked once for "yes"
- **Step 4:** Just to make sure I understand you correctly, I will ask the same question for the other shirt. (repeat step 2-3 for the other shirt).

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Interpreting Mixed Results

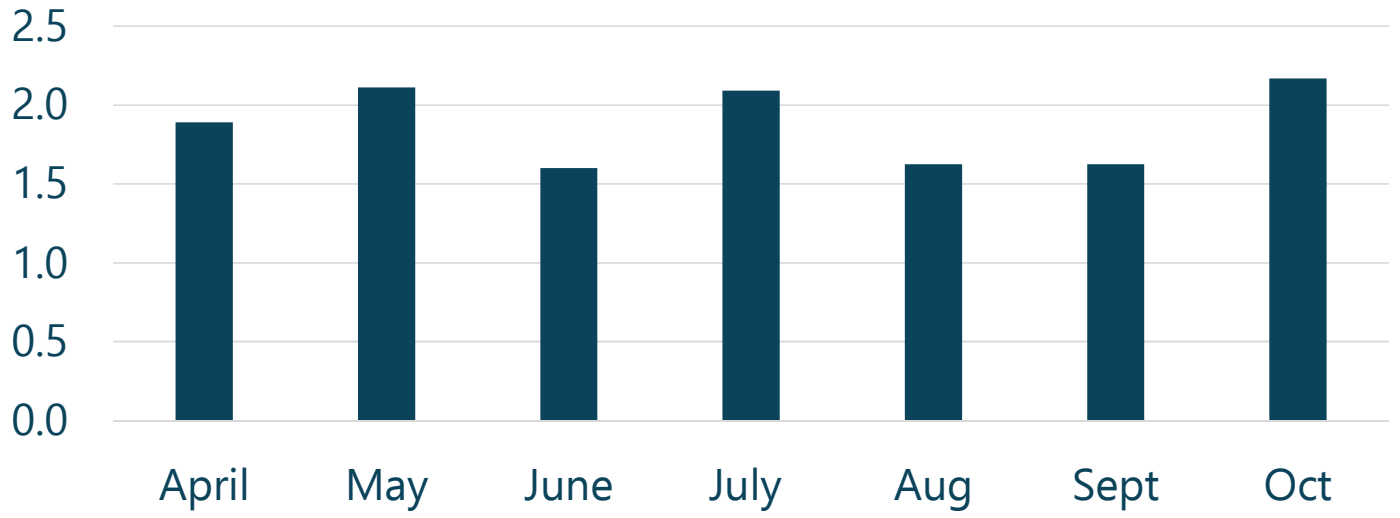
3 = open/closed hand with verbal command only

2 = open/closed hand with command and demonstration

1 = open/closed hand with command, demonstration, and physical cue

0 = no movement of fingers on right hand

Command – "Open/close your right hand"



Effectiveness of Sensory Stimulation Programs

Right Hand Use (Numbers)

- 5 = able to show all 5 numbers correctly
- 4 = able to show 4/5 numbers correctly
- 3 = able to show 3/5 numbers correctly
- 2 = able to show 2/5 numbers correctly
- 1 = able to show 1/5 numbers correctly

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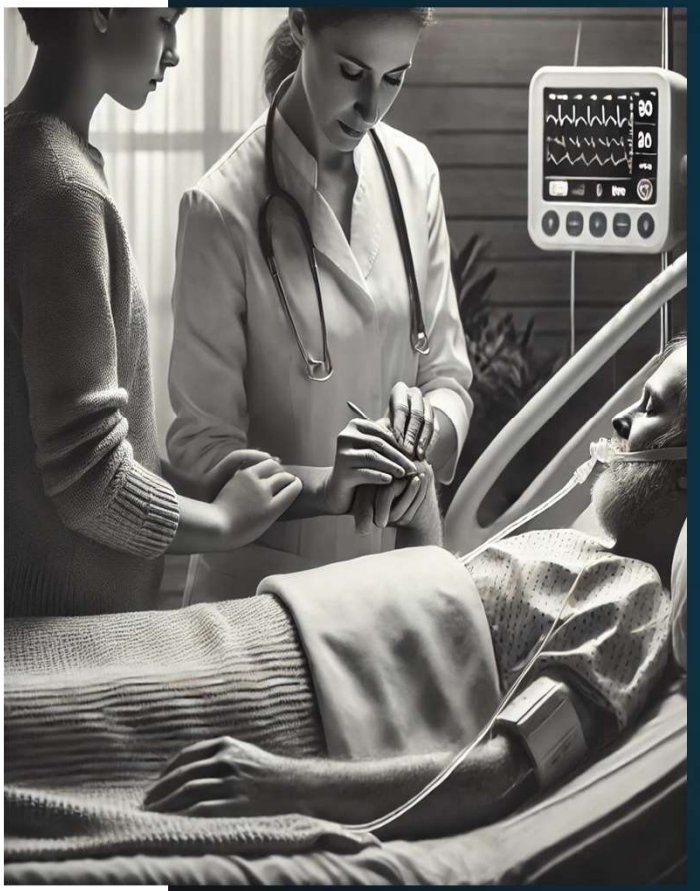
Right Hand Use

Question: “What do you want to do with the PUMPKIN?”

		
PAINT	CARVE	REUSE
1	3	5

Patient Progress and Family Integration



Patient Progress:

- Improved responsiveness, including eye tracking and localized responses.
- Enhanced cognitive and physical engagement.
- Long-term positive outcomes from consistent stimulation.

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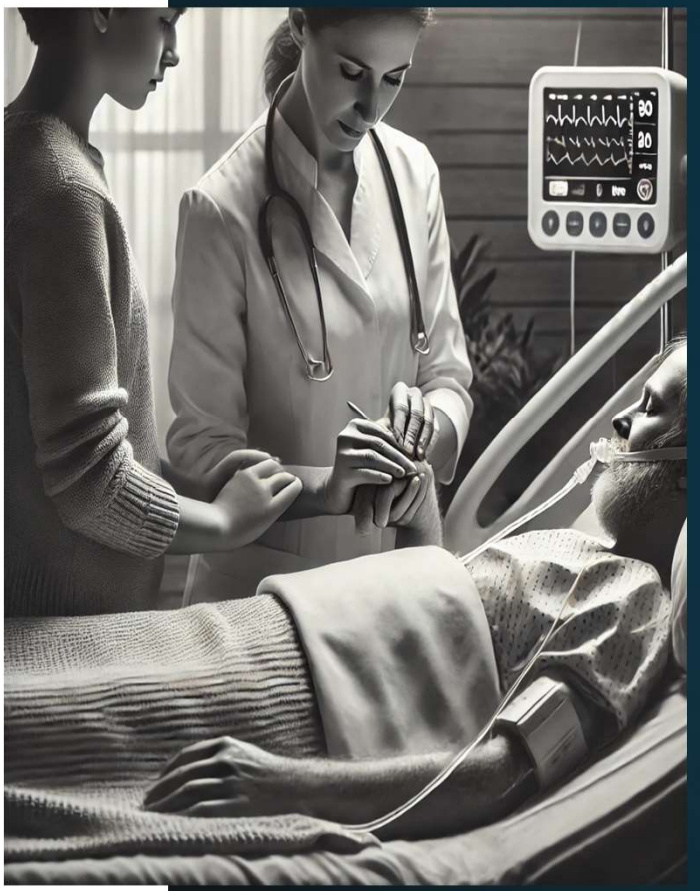
Patient Progress and Family Integration

Family Roles:

- Provide input on meaningful stimuli.
- Actively support program goals during sessions.
- Strengthen the emotional and motivational connection with the patient.



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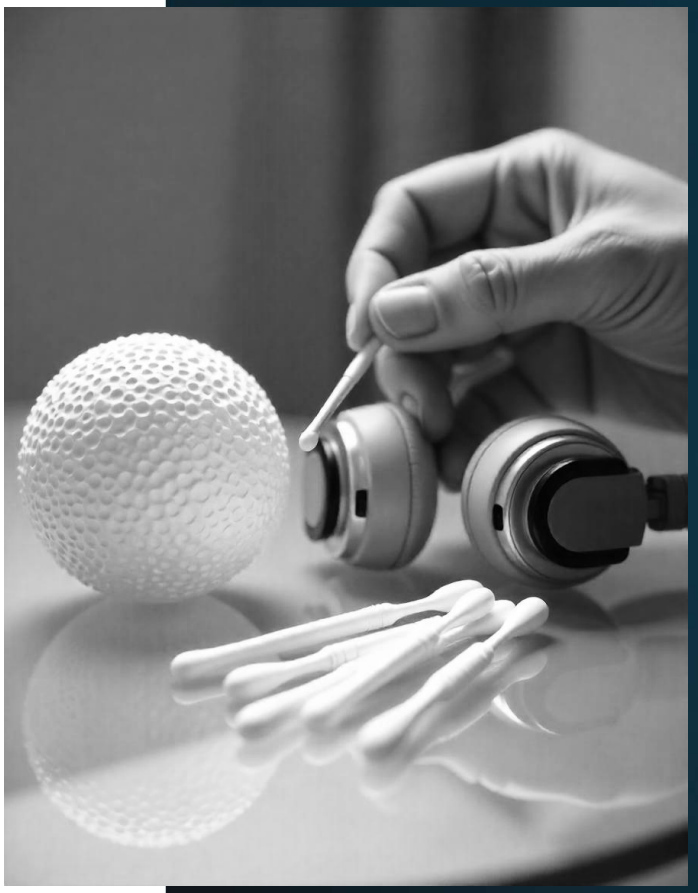
Overcoming Challenges and Delivering Impact

- Education is crucial.
- Limited resources for lower-functioning patients.
- Difficulty in assessing responses.
- Progress is slow.
- Communication and consistency are key.
- Habituation happens.



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Building on What We Know

Key Program Insights

- Update sensory programs regularly to maintain engagement.
- Training is key to consistency and success.
- Family and friends play a crucial role in therapy.
- Orientation boards help staff connect with client needs.

Building on What We Know

Tools and Technology

- Electronic data collection tools (e.g., MS Forms) can be both helpful and challenging.
- Technologies and tools evolve; *staying up to date is critical*.
- Joint sessions improve knowledge-sharing and handling strategies.

Family Testimonials

"Now 'M' is very happy and relaxed where he is living…His sense of humor has returned and he is out enjoying movies, art class, music class, and cooking…There are no words to describe how this has changed our lives…We now have peace of mind that he is exactly where he belongs, that he is safe and will be able to live out his life happily."

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Family Testimonials

"Until these tragedies impact people personally, the struggles ABI families face remain misunderstood. Being turned away repeatedly is devastating... Imagine being told you don't qualify for help or it's too late, even as you continue to make small improvements."

"Imagine if my husband and family had been given proper opportunities instead of being treated as statistics... What message does it send when hope is prematurely stripped away? Reflect on this: Are we doing everything to support others? How would you want your loved ones to be treated—with every chance to achieve the best outcome without constant battles?"

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Resources

- Coma Recovery Scale – Revised
  - Centre for Outcome Measurement in Brain Injury (COMBI) - JFK Coma Recovery Scale-Revised
  - Shirley Ryan Ability Lab - Coma Recovery Scale – Revised | RehabMeasures Database
- Coma Near Coma Scale - The Coma/Near Coma Scale
- Rancho Los Amigos Scale- Level of Cognitive Functioning Scale
- Disorders of Consciousness Scale (DOC-25) - Disorders of Consciousness Scale | RehabMeasures Database
- Dr. John Connolly (McMaster University)
- Dr. Adrian Owen (Wester University)

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