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Speech Therapist Directed use of Computer Assisted Cognitive Rehabilitation (CACR) for Patients with Acquired Brain Injury

Clinical Question

- P (population/problem) Among pediatric patients with acquired brain injury
I (intervention) does speech therapist directed use of computer-assisted cognitive rehabilitation (CACR) in addition to traditional rehabilitative cognitive-linguistic speech therapy
C (comparison) versus traditional rehabilitative cognitive-linguistic speech therapy alone
O (outcome) decrease impairment and improve functional independence?

Target Population

Inclusion: Pediatric patients (ages 3 to 21 years) that have sustained acquired brain injury (ABI), including traumatic brain injury (TBI), brain tumor, arteriovenous malformation (AVM), seizure disorder, meningitis, encephalitis, cerebrovascular accident (CVA), and hydrocephalus

Exclusion: Patients with neurological impairments that are hereditary; patients with psychological diagnosis prior to injury; patients with severe visuospatial deficits which impact their ability to complete tasks on a computer screen

Recommendation (See Table of Recommendation Strength)

It is recommended that pediatric patients with acquired brain injury use computer-assisted cognitive rehabilitation when directed by a speech-language pathologist to decrease impairment in:

- processing speed (Bangirana 2009 [2b]; Kesler 2011 [4a]),
- attention (Thornton 2008 [1b]; Circerone 2011 [1b]; Bangirana 2009 [2b]; Thorell 2009 [2b]; Kesler 2011 [4a]; Chen 1997 [4b]),
- working memory (Thorell 2009 [2b]; Klingberg 2005 [2b]; Kesler 2011 [4a]; Chen 1997 [4b]),
- inhibition (Thorell 2009 [2b]; Klingberg 2005 [2b]),
- memory ((Thornton 2008 [1b]; Circerone 2011 [1b]; Bangirana 2009 [2b]; Dou 2006 [2b]; Lolyd 2009 [2b]; Bergquist 2009 [2b]; Sweeney 2010 [2b]; Kesler 2011 [4a]; Chen 1997 [4b])
- problem solving (Thornton 2008 [1b]; Klingberg 2005 [2b]; Man 2006 [2b]; Chen 1997 [4b]).

Discussion/Summary of Evidence related to the recommendation

Processing Speed

Two pediatric studies use Captain's Log cognitive training software and Lumos Labs, Incorporated software two times per week up to five times per week with patients with encephalitis and brain tumor. The studies revealed calculated effect sizes of .59 and 1.0 effect sizes with an overall average of 0.79 in processing speed as determined by neuropsychological measures and functional magnetic resonance imaging (fMRI) (Bangirana 2009 [2b]; Kesler 2011 [4a]).

Attention

Combined electroencephalogram (EEG) biofeedback and computer training (Captain's Log, Cogmed, Lumos Labs, Inc., The Bracy Process Approach) demonstrated a broad range in calculated effect sizes from 0.13 to 1.1 effect with an overall average of 0.41 in attention. The greatest effect size (1.1) was found with use of cognitive software from Lumos Labs, Inc. with pediatric patients, ages 7-19 (Thornton 2008 [1b]; Circerone 2011 [1b]; Bangirana 2009 [2b]; Thorell 2009 [2b]; Kesler 2011 [4a]; Chen 1997 [4b]).

Working Memory

Several interventions, including RoboMemo (Cogmed), Lumos Labs, Inc. and The Bracy Process Approach, revealed a broad range of calculated effect sizes including 0.19 to 1.15 effect sizes with an overall average of 0.54 in working memory. Thorell demonstrated the greatest effect size (1.15) by use of cognitive software from Cogmed with children ages 4-5 years (Thorell 2009 [2b]; Klingberg 2005 [2b]; Kesler 2011 [4a]; Chen 1997 [4b]).

Inhibition

Both pediatric studies used software developed by Cogmed and both revealed small calculated effect sizes of 0.23, 0.25 and 0.34 with an overall average effect size of 0.27 for inhibition. Klingberg used Robomemo software with children ages 7 to 12 years for the greatest effect sizes of 0.57, 0.59 and 0.93 (Thorell 2009 [2b]; Klingberg 2005 [2b]).

Memory

A combined use of errorless learning, computerized interventions, and compensatory strategies is recommended. All studies revealed 0.19 to 0.61 calculated effect sizes with an overall average of 0.37 effect size in memory (Thornton 2008 [1b]; Circerone 2011 [1b]; Bangirana 2009 [2b]; Dou 2006 [2b]; Lolyd 2009 [2b]; Bergquist 2009 [2b]; Sweeney 2010 [2b]; Kesler 2011 [4a]; Chen 1997 [4b]).

Problem Solving

All studies revealed 0.14 to 0.46 calculated effect sizes with an overall average of 0.27 in problem solving. Man 2006, found that patients who received instructions in person showed more significant improvement in self-efficacy than the groups receiving online training only (Thornton 2008 [1b]; Klingberg 2005 [2b]; Man 2006 [2b]; Chen 1997 [4b]).

Reference List

(Evidence Level in []; See Table of Evidence Levels following references)

- Bangirana, P., Giordani, B., John, C. C., Page, C., Opoka, R. O., & Boivin, M. J. (2009). Immediate neuropsychological and behavioral benefits of computerized cognitive rehabilitation in Ugandan pediatric cerebral malaria survivors. *Journal of Developmental and Behavioral Pediatrics, 30*, 310-318. [2b]
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- Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlstrom, K., Gillberg, C. G., Forsberg, H., & Westerberg, H. (2005). Computerized training of working memory in children with ADHD- A randomized, controlled trial. *Journal of American Academic Child Adolescent Psychiatry, 44*(2), 177-186. [2b]
- Lolyd, J., Riley, G. A., & Powell, T. E. (2009). Errorless learning of novel routes through a virtual town in people with acquired brain injury. *Neuropsychological Rehabilitation, 19*(1), 98-109. [2b]
- Man, D. W. K., Soong, W. Y. L., Tam, S. F., & Hui-Chan, C. W. Y. (2006). Self-efficacy outcomes of people with brain injury in cognitive skill training using different types of trainer-trainee interaction. *Brain Injury, 20*(9), 959-970. [2b]
- Sweeney, S., Kersel, D., Morris, R. G., Manly, T., & Evans, J. J. (2010). The sensitivity of a virtual reality task to planning and prospective memory impairments: Group differences and the efficacy of periodic alerts on performance. *Neuropsychological Rehabilitation, 20*(2), 239-263. [2b]
- Thorell, L. B., Lindqvist, S., Bergman Nutley, S., Bohlin, G., & Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental Science, 12*(1), 106-113. [2b]
- Thornton, K. E. & Carmody, D. P. (2008). Efficacy of traumatic brain injury rehabilitation: Interventions of QEEG-guided biofeedback, computers, strategies and medications. *Applied Psychophysiological Biofeedback, 33*, 101-124. [1b]

Supporting Information

Background / Purpose of BEST Development

The clinical question was derived from noting variations in the standard of care by speech therapists with performing cognitive rehabilitation with patients with acquired brain injury. This project was initiated to improve

consistency of care, to determine a protocol for a model of care with patients who have acquired brain injury, to improve the flow of patients through outpatient rehabilitation, to improve patient and family satisfaction and to potentially decrease expense and increase revenue for the hospital.

Applicability Issues

- Proper education and training of computer-assisted cognitive rehabilitation for staff involved in the care of patients with acquired brain injury.
- Appropriate documentation tools are required to monitor use of CACR during treatment and/or during home program.
- A valid and reliable outcome measure is needed to measure functional independence.

Outcome or Process Measures

Neuropsychological measures can be used to measure progress in treatment, as well as standardized outcome measures to assess functional independence. The Mayo-Portland Adaptability Inventory-4 (MPAI-4) measures motor speech, verbal communication, nonverbal communication, attention, memory, fund of information, novel problem-solving, social interaction and self-awareness and can be used every six months to measure clinical progress.

Search Strategy

Date range: 1995-April 2011

Keywords: brain/head injury, neurological injury, acquired/traumatic brain injury, brain tumor, stroke, CVA, speech therapy/pathology, computer, computer assisted cognitive rehabilitation, cognitive rehab/rehabilitation, child/children

Databases: CINAHL, Ovid, Medline, Pubmed, Cochrane Library, Scopus, EBSCO, ASHA, PsychInfo, ERIC, Google Scholar, National Guideline Clearinghouse (www.guidelines.gov)

Relevant CCHMC Evidence-Based Documents

Guidelines, other BESTs, policies, procedures, Knowing Notes, or Health Topics

None were found.

Group/Team Members

Group/Team Leader:

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Conflicts of Interest were declared for each team member and:

- No financial conflicts of interest were found.
 The following financial conflicts of interest were disclosed:

Note: Full tables of evidence grading system available in separate document:

- [Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality](#) (abbreviated table below)
- [Grading a Body of Evidence to Answer a Clinical Question](#)
- [Judging the Strength of a Recommendation](#) (abbreviated table below)

Table of Evidence Levels (see note above)

Quality level	Definition
1a+ or 1b+	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5a or 5b	General review, expert opinion, case report, consensus report, or guideline
5	Local Consensus

†a = good quality study; b = lesser quality study

Table of Recommendation Strength (see note above)

Strength	Definition
It is strongly recommended that... It is strongly recommended that... not...	There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations).
It is recommended that... It is recommended that... not...	There is consensus that benefits are closely balanced with risks and burdens.
There is insufficient evidence and a lack of consensus to make a recommendation...	

Dimensions for Judging the Strength of the Recommendation

Reflecting on your answers to the dimensions below and given that more answers to the left of the scales indicates support for a stronger recommendation, complete one of the sentences above to judge the strength of this recommendation.
(Note that for negative recommendations, the left/right logic may be reversed for one or more dimensions.)

1. Grade of the Body of Evidence	<input type="checkbox"/> High	<input checked="" type="checkbox"/> Moderate	<input type="checkbox"/> Low
2. Safety / Harm (Side Effects and Risks)	<input checked="" type="checkbox"/> Minimal	<input type="checkbox"/> Moderate	<input type="checkbox"/> Serious
3. Health benefit to patient	<input type="checkbox"/> Significant	<input checked="" type="checkbox"/> Moderate	<input type="checkbox"/> Minimal
4. Burden on patient to adhere to recommendation	<input type="checkbox"/> Low	<input checked="" type="checkbox"/> Unable to determine	<input type="checkbox"/> High
5. Cost-effectiveness to healthcare system	<input checked="" type="checkbox"/> Cost-effective	<input type="checkbox"/> Inconclusive	<input type="checkbox"/> Not cost-effective
6. Directness of the evidence for this target population	<input type="checkbox"/> Directly relates	<input checked="" type="checkbox"/> Some concern of directness	<input type="checkbox"/> Indirectly relates
7. Impact on morbidity/mortality or quality of life	<input type="checkbox"/> High	<input checked="" type="checkbox"/> Medium	<input type="checkbox"/> Low

Comments on Dimensions:

There was variability in the populations cited in the research. Most studies used adult populations.
The impact on morbidity/mortality is none. The impact on quality of life is medium.

Copies of this Best Evidence Statement (BEST) and related tools (if applicable, e.g., screening tools, algorithms, etc.) are available online and may be distributed by any organization for the global purpose of improving child health outcomes.

Website address: <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>

Examples of approved uses of the BEST include the following:

- copies may be provided to anyone involved in the organization's process for developing and implementing evidence based care;
- hyperlinks to the CCHMC website may be placed on the organization's website;
- the BEST may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at EBDMinfo@cchmc.org for any BEST adopted, adapted, implemented, or hyperlinked by the organization is appreciated.

Please cite as: Cincinnati Children's Hospital Medical Center: Best Evidence Statement: Speech Therapist Directed use of Computer Assisted Cognitive Rehabilitation (CACR) for Patients with Acquired Brain Injury, <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>, BEST 111, pages 1-6, 8/23/2011.

This Best Evidence Statement has been reviewed against quality criteria by 2 independent reviewers from the CCHMC Evidence Collaboration.

For more information about CCHMC Best Evidence Statements and the development process, contact speech@cchmc.org.

Note

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.