DOES TELE-HEALTH TRAINING STACK UP TO ON-SITE EXECUTIVE CONTROL TRAINING FOR YOUTH AND ADULTS WITH TBI?

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Medical practitioners have long recognized potential contributions that tele-health (also referred to as tele-medicine or tele-practice) can make regarding equitable access of services, especially in rural and remote populations (Scalvini, et al., 2004). Tele-health has become integral to many hospitals to (1) increase patient access to care, (2) enable health care providers to connect with patients, (3) provide consultation, health monitoring, mental health services, education, pharmacological services, and (4) offer counselling. According to American Hospital Association (2015), 52% of hospitals utilized some form of tele-health in 2013, and the number of hospitals and other medical institutions adopting tele-health approaches is expected to increase in the coming years. For example, Mercy Health Care System in Missouri and Jefferson University Hospitals in Philadelphia are making significant investments in establishing tele-health practices including primary and specialty care services.

Emerging findings from multiple medical specialties suggest comparability between face-to-face and tele-health care practices on selected topics. For example, the National Center for Telehealth and Technology recently reported comparable effects between tele-therapy (video and tele conferencing) and standard care (face-to-face therapy) in reducing depressive symptoms in active-duty service members (Osenbach, 2014). In another study, the Veterans Health Administration's use of tele-home monitoring of vital signs resulted in a 51% reduction in hospital readmissions for heart failure and a 44% drop in readmissions for other conditions (American Hospital Association, 2015).

Patients and caregivers are also more open to tele-health approaches. Over 70% of the patients surveyed are willing to use tele-health services, especially if it provides timely access to providers and improves quality of life (American Hospital Association, 2013). In addition to improved health care and patient satisfaction, researchers are examining the economic impact of tele-health services. According to Towers Watson group, a global professional services company, switching from in-person to tele-health visits, when appropriate, could save U.S. companies up to $6 billion a year (Osenbach, 2014).

Although the medical community has long recognized the significance of remote health-delivery, tele-cognitive rehabilitation in TBI care is in its infancy and scientists/clinicians have only begun to examine its efficacy (Seelman and Hartman, 2009). If effective, tele-cognitive rehabilitation services can offer promising options to serve the growing number of individuals with TBI across diverse etiologies. This could include assessment, treatment and long-term monitoring that can optimize function and prevent/moderate later emerging deficits or declines in cognitive capacities (Corrigan and Hammond, 2013). Based on demonstrated efficacy, tele-cognitive rehabilitation could reduce some current day impediments to accessing continuing care such as geography, disability, scheduling, time, transportation, resources, companion support and other factors that impede on-site services.

TBI Tele-cognitive Rehabilitation

Current tele-cognitive rehabilitation uses information and communication technologies such as instant messaging, telephones, two-way audio-video interactions, and online services (Brennan, et. al., 2010). Existing tele-cognitive rehabilitation primarily targets training to compensate for deficits in memory, attention, or targeted goal accomplishment. Memory training strategies include calendar use, spaced retrieval, associations, verbal rehearsal, imagery, and written reminders (Bergquist, et al., 2009; Diamond, et al., 2003; Melton and Bourgeois, 2005). A handful of studies have examined the feasibility of tele-problem solving training in youth (Karver et al., 2014; Wade, et al., 2010; Wade et al., 2011) and adults Ng, et al., 2013: Soong, et al., 2005). Results demonstrated effective use of calendars to self-direct attention to scheduled tasks, improvement in memory, and targeted goal accomplishment using problem-solving strategies (Bergquist et al., 2009; Bourgeois et al., 2007; Egan, Worral and Oxenham, 2005). Tele-cognitive rehabilitation platforms are also becoming more prevalent in improving TBI care in military settings and within the Veterans Administration centers (Braverman, et al., 1999; Girard, 2007).

Ongoing studies at BrainHealth are extending the existing array of tele-cognitive training paradigms to determine the feasibility and effectiveness of delivering an executive control training program through a two-way audio-video internet format. The current studies are the first, to our knowledge, to suggest similar patterns of gains between on-site and tele-health delivery of an executive control training program among youth and adults who sustained a TBI years prior to training.

The SMART program, in both tele-health (henceforth referred to as tele-SMART) and on-site formats, trains executive control strategies of strategic attention, integrated reasoning, and innovation using a top-down training approach (Chapman, 2013; Chapman and Mudar, 2014). Strategic attention strategies focus on blocking distractions and irrelevant input. The importance of avoiding multitasking and taking regular mental breaks for improved cognitive performance and productivity are also a key part of the training. Integrated reasoning strategies build on strategic attention to facilitate abstract thinking abilities. Abstracting meanings or ideas (e.g. take home messages) from information (e.g. videos, news articles, and conversations) is practiced extensively during integrated reasoning. Engagement of cognitive control processes is further facilitated by innovation strategies of flexible thinking. Examining information from divergent perspectives during innovation strengthens problem-solving abilities.

The SMART strategies are introduced in a sequential manner in a Power Point format. Mastery of individual strategies is not necessary to move on to the next level, as strategies are continually reinforced at each stage of the program. Teaching material includes preselected materials of varying lengths from different modalities (e.g. audio, video, textual) and patient selected information or goals. Regular homework assignments following each session reinforce application and carryover of strategies into daily life. These multidimensional and interrelated strategies can be applied to a wide range of academic materials, work responsibilities and everyday tasks to improve efficiency and independence.

Assessing Feasibility

Two feasibility studies were conducted separately with youth and with adult groups. Combined, the studies included individuals with both mild and moderate injuries (although most youth were in the mild injury range), who were at least six months post-injury. Most of the 14 youth (ages 14 – 19 years of age at testing) were injured due to sports/recreational related activities. In the adult TBI study (n=15, ages 22-65, including civilians and veterans), mechanisms of injury were mixed across participants and included motor vehicle accidents, blast injuries, and sports-related concussions. Pre and post-training assessments in both formats were conducted on-site. Table 1 highlights differences in the two models during actual training.

Preliminary results within both groups reveal significant post tele-SMART gains in executive control domains of abstract reasoning and memory measures, including short term and delayed recall of facts and details. Furthermore, tele-SMART gain patterns were similar to ongoing on-site SMART program outcomes in both youth and adult TBI populations (Figure 1).

As noted in Figure 2, adult participants in both groups reported a reduction in depressive symptoms on the Beck Depression Inventory following training. Parents of children who participated in the training also reported improvement in executive function as noted in their pre and post BRIEF assessments.

TABLE 1 Strategic Memory Advanced Reasoning Training (SMART)

	Tele-SMART	On-Site
Training Format	Individual	Groups (4-6 participants)
Total number of training hours	8-10*	12-18
Total number of sessions	8-12	8-12
Duration of each session	45-60* minutes	60-90 minutes

*The reduced number of hours and duration of each session in the tele-SMART paradigm reflects the decreased amount of time needed to train participants individually.

Data Considerations

The similar results between on-site and tele-SMART training lead us to consider the additional benefits of "environmental salience" when adapting cognitive training into daily life. Anecdotal reports from our off-site study participants highlighted the benefits of receiving cognitive training in their "own rooms." They reported that the flexibility and access to training in their own homes was empowering. Furthermore, tele-health technology significantly reduced travel time and the fatigue often associated with travel. The flexibility of this approach also provided additional advantage to clinicians' schedules. We plan to incorporate long-term follow up (e.g. 6-months, one year) into the current protocol. Additionally, we intend to expand the current individual-training format to test group tele-SMART sessions. This will better determine what significance the individual tele-SMART training had over the group on-site training in the present investigations, as well as the basic efficacy of the approach in cognitive tele-health treatment. Tele-group training will share similar benefits of in-person group training of encouragement, support, motivation, opportunity for interactive discussion and problem solving.

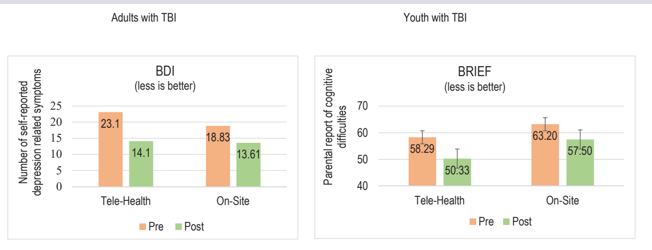
FIGURE 1 Comparison of Tele-Health vs. On-Site changes from Pre-SMART to Post-SMART

Note: All pre to post-test differences within the Tele-Health and On-Site groups were statistically significant at p< .05 or lower.

Challenges

Whereas tele-cognitive rehabilitation has numerous benefits including easy access and timely delivery, remote platforms are not without challenges. Clinicians need to be cognizant of at least four logistical issues associated with remote tele-cognitive

FIGURE 2 Comparison of Tele-Health vs. On-Site changes from Pre-SMART to Post-SMART



Note: BDI-Beck Depression Inventory, BRIEF- Behavior Rating Inventory of Executive Function. All pre to post-test differences within the Tele-Health and On-Site groups were statistically significant at $p < .05$ or lower.

rehabilitation. First, extra precautions are required to protect privacy and confidentiality, especially when training is delivered on a publicly available internet platform. For example, the popularly used Skype platform may be less secure compared to other available platforms. Internet platforms such as Cisco WebEx Meetings, Citrix GoToMeeting and Blue Jeans promise a secure virtual room/space for audio-video interactions. Second, poor internet connections can cause delays and disruptions in training delivery. While trainees may have limited control in this matter, alternative options of training sites with uninterrupted internet access (e.g. public library with private rooms) could be considered. Third, potential in-home distractions including pets and small children could interfere with training sessions. In our studies, clinicians discussed strategies for how to reduce distractions at the beginning of the sessions. This can also be a training opportunity to learn how to manage distractions. Fourth, trainees and clinicians may take undue advantage of the flexibility offered by tele-cognitive training. Care must be taken to adhere to scheduled sessions just as in face-to-face appointments. Our experience with trainees from around the country has also made us keenly aware of considering time zone differences for scheduling training sessions, including sleep-wake cycles.

Future Initiatives

Large-scale multi-site trials are needed to establish and validate comparable effectiveness between on-site and tele-cognitive training. Effective validation of tele-cognitive rehabilitation programs for people with TBI could produce significant clinical, economical, and policy implications. From a clinical perspective, tele-cognitive rehabilitation could offer substantial ways to improve and extend standard TBI cognitive practice by adding a practical way to monitor and treat people at later stages post-injury. With larger sample sizes, researchers should be able to discern which patient characteristics (e.g., severity, age, level of impairment, etc.) are associated with those who may benefit best from tele-training approaches versus others who may need on-site services to optimize cognitive abilities. As we enroll more participants, we plan to distinguish and characterize tele-SMART responders versus non-responders on cognitive and functional indices. Another key question is whether tele-cognitive rehabilitation is effective in group settings compared to one-on-one tele-health treatments.

Evidence from randomized trials directly comparing tele-cognitive versus on-site rehabilitation could lead to increased support from health care policy makers and subsequently reimbursement from insurance companies. According to American Telemedicine Association (Thomas and Capistrant, 2015), twenty-four states and the District of Columbia have laws that require private insurers to reimburse for some tele-medical services. Forty-seven states offer some form of tele-health coverage through Medicaid services. Policy makers are also becoming aware of the growing trend in tele-health practices. A bipartisan coalition in Congress is working on legislation to improve access to covered telehealth services in Medicare (American Hospital Association, 2015). Rehabilitation clinicians and researchers have a significant opportunity and a major responsibility to improve tele-cognitive rehabilitation as a viable health care delivery option for people with TBI. It is also important to stay abreast of emerging research comparing the relative effectiveness of in-person and tele-approaches for other clinical topics and issues. Positive findings may induce support from health policy makers to help to pave the way for reimbursement of meaningful tele-cognitive rehabilitation services.

Conclusions

Tele-cognitive training is beginning offer promise for people with TBI. This treatment platform increases the potential to offer people state-of-the-art interventions that may previously only have been available on-site. Additionally, tele-health offers a venue to more easily sustain continuing follow-up and maintenance services at regular intervals and at a lower cost. Emerging positive findings from the current study inform the feasibility of delivering an executive control cognitive training program via a duplex audio-video internet format. These findings, combined with previous evidence, encourage rehabilitation professionals to test the feasibility of integrating tele-cognitive rehabilitation into their practices. Tele-rehabilitation can also include screenings, assessments, training, treatment maintenance, and long-term monitoring across the lifespan. It is applicable to continuum of care settings such as rehabilitation centers, clinics, schools, and long-term care. Effective advances can provide easier health care accessibility for those living in remote settings and offer training at later post injury stages to optimize cognitive recovery and improve both productivity and quality of life.

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