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Mr. Alan Bolster
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**RE: Final Progress Report for "Teen Online Problem Solving for
Adolescent Traumatic Brain Injury"**

Dear Mr. Bolster

Please find one final progress report for the above study.

Should you have questions or need additional information please call
Amanda Owen, Sponsored Projects Officer at (614) 355-3414.

Sincerely,

Amanda Owen, MPA
Sponsored Projects Officer
The Research Institute at Nationwide Children's Hospital
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EMS/Trauma Research Grant Final Project Report

Date: November 20, 2009

Title: Teen Online Problem Solving for Adolescent Traumatic Brain Injury

Funding period: July 1, 2008-September 30, 2009

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Introduction

Traumatic brain injury (TBI) is a leading cause of death and disability in children¹. More than a million children and youth suffer from TBI each year². A child or adolescent who survives a severe TBI faces an uncertain future. Previous research suggests that severe TBI in childhood and adolescence results in significant and life-long disability in a substantial proportion of survivors³. Mental health and education interventions based on sound scientific findings are required to facilitate the recovery and adjustment of these children and their families. However, virtually no empirically-based interventions exist. The current project began to address these needs by examining the efficacy of an innovative online intervention for adolescents with TBI (Teen Online Problem Solving: TOPS). The project compared the effects of TOPS to that of an internet resource comparison group (IRC) on adolescent behavioral adjustment, parent burden and distress, and parent-teen conflict. The findings suggest that the TOPS intervention is successful at reducing teen behavioral difficulties and improving family functioning relative to the IRC.

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Executive Summary

Traumatic brain injury (TBI) in adolescents is a significant stressor for both the teens and their families, and often results in significant disability for youth and distress for their families. Existing interventions to promote better outcomes are rare and access to treatment can be restricted by distance and finances. The current project addressed these needs by examining the efficacy of an innovative online intervention for adolescents with TBI, Teen Online Problem Solving (TOPS). The TOPS intervention was adapted based on input from teens with TBI about a recently developed online program for school-aged children with TBI and their families, and emphasizes the development and remediation of executive function skills including self-awareness, self-regulation, planning, and problem solving.

The project extended a randomized clinical trial of TOPS supported by the National Institute on Disability and Rehabilitation Research, by enabling recruitment of additional participants during the funding period. The efficacy of TOPS was tested by comparing its effects to that of an internet resource comparison group (IRC) on the following outcomes: 1) adolescent executive function skills and behavioral adjustment; 3) parent burden and distress; and 4)

parent-teen conflict.

Participants included 42 families of children, aged 11–18 years, who experienced a moderate to severe TBI in the previous 18 months. They were recruited at Nationwide Children’s Hospital in Columbus, OH and Cincinnati Children’s Medical Center in Cincinnati, OH. The average age of participants was approximately 14 years. Their average Glasgow Coma Scale score was approximately 10 (range 3-15), with 43% having severe TBI and 57% mild-moderate TBI. The children lived up to 3 hours from the participating hospitals, thus giving the project broad regional impact.

Families were randomly assigned to IRC or TOPS. Each family received a computer if they did not already own one, and Internet access to online TBI information and resources. Families in the TOPS group completed up to 16 online sessions with a therapist who provided 10 sessions focusing on problem solving, communication, and social skills training, with additional sessions focused on the stressors and burdens of individual families. We hypothesized fewer teen emotional/behavioral problems, less parental burden and distress, and less parent-teen conflict at follow-up among the TOPS group compared to the IRC group.

Participant ratings of TOPS ease of use, satisfaction, and helpfulness were uniformly high. Additionally, both parents and teens receiving the TOPS intervention reported significantly greater improvements in teen executive function skills and behavior than those in the IRC group. However, parent and teen perceptions of the nature of these improvements varied, with parents in the TOPS group reporting greater improvements in the teen’s emotion control, planning and organization, and internalizing symptoms than those in the IRC. Conversely, teens receiving TOPS reported greater improvements in inhibition, organization of materials, and externalizing symptoms than those in the IRC group. Additionally, parents but not teens receiving TOPS reported significant reductions in parent-teen conflicts. These findings suggest that TOPS and other problem solving interventions may be effective in reducing emerging executive dysfunction and behavior problems following TBI in teens. However, the findings also

underscore the need to consider differences in parent versus teen perceptions of functioning and relationships when evaluating treatment outcomes in this population.

No previous randomized clinical trials have addressed the unique psychosocial needs of adolescents with TBI and their families. The project provides critical information about: 1) the efficacy of online interventions following adolescent TBI; and 2) the types of families and children most likely to benefit from this type of approach. The study helps lay the foundation for subsequent investigations of the effectiveness of this approach when translated to clinical settings. The results suggest the potential for making interventions available to families of adolescents with TBI throughout the state of Ohio at a relatively low cost. The treatment holds particular promise for vulnerable and hard-to-reach populations in central and southern Ohio who face substantial barriers to treatment (e.g., distance, cost, stigma).

Information/Qualifications of the Investigators

Principal investigators include Keith Owen Yeates, Ph.D. and Shari L. Wade, Ph.D. Dr. Yeates is a Professor in the Departments of Pediatrics, Psychology, and Psychiatry at The Ohio State University. He is the Director of the Center for Biobehavioral Health in the Research Institute at Nationwide Children's Hospital and Chief of the Department of Psychology at Nationwide Children's Hospital. Dr. Yeates is involved in federally-funded research on the outcomes of childhood brain disorders and has held an Independent Scientist Career Development Award from the National Institutes of Health. Dr. Wade is a Research Professor and Director of Research within the division of Physical Medicine and Rehabilitation at Cincinnati Children's Hospital Medical Center and principal investigator on six federally-funded projects investigating recovery following TBI in childhood. Drs. Yeates and Wade have collaborated successfully together for nearly two decades, co-authoring nearly 30 peer-reviewed publications and numerous presentations. Both are recognized as leaders in the field of pediatric traumatic brain injury research.

Review of the Literature

Traumatic brain injury (TBI) in childhood contributes to long-term behavioral, social, and family difficulties^{1,3}. Although TBI in adolescence has received limited attention, existing research suggests that the developmental transitions of adolescence may be more difficult to negotiate following a brain insult, particularly if the injury involved the frontal lobes of the brain. Adolescents with TBI may experience deficits in executive functions (EF), problem solving, and social/pragmatic communication⁴⁻⁵. These deficits may become increasingly noticeable in middle school and high school, when social and academic demands increase and students begin vocational and career planning. Restrictions on activities and limits on emerging independence following TBI in adolescence may result in social isolation, exclusion, and depression. Research on adult outcomes of TBI also highlights loneliness, social interaction difficulties, and fewer friendships as frequent and persisting consequences of injury⁶. Thus, timely behavioral intervention following TBI in adolescence may serve to reduce longer-term disability and social isolation.

Several recent review articles⁷⁻¹⁰ underscore the dearth of empirically-based treatments for the social and behavioral difficulties caused by childhood TBI. More importantly, treatment approaches specifically addressing the behavioral consequences of TBI in adolescents are woefully lacking. The lack of established behavioral treatments for pediatric TBI may be attributable in part to the unique barriers to care facing many families. Because many children with TBI receive treatment at urban trauma centers serving large geographic areas, at a distance from their homes, returning for outpatient counseling may be impossible or unduly time-consuming. However, local providers may lack requisite knowledge and expertise regarding TBI. Thus, families must choose between traveling long distances or forgoing services. Additionally, acute trauma and rehabilitative care for adolescents is often divided between pediatric and adult facilities, resulting in adolescents being grouped with younger children or with adults. Scheduling issues (school, sports, job) and resistance to counseling

pose additional barriers to care.

Given these considerations, adolescents with TBI may be particularly able to benefit from interventions delivered via computer or the World Wide Web (Web) that eliminate barriers to treatment such as time, distance, and the unavailability of providers. Recent surveys indicate that 93% of teenagers are online, making them excellent candidates for online treatments. Although a number of websites currently provide information and referrals regarding brain injury, most information is geared toward adult TBI. Additionally, no existing website provides one-to-one, synchronous assistance in coping with the challenges of TBI sequelae.

To address these needs, we developed and piloted Teen Online Problem Solving (TOPS). TOPS is a web-based treatment program that emphasizes the development and/or remediation of foundational EF skills including self-awareness, self-regulation, planning, and problem solving and incorporates training in language pragmatics and social information processing (SIP) to address the deficits in social competence resulting from TBI. Preliminary findings from a pilot with 9 families of teens with moderate to severe TBI suggested that the program was feasible and acceptable to both teens and their families. Parents and teens rated the specific website content on brain injury, problem solving, self regulation, communication, and anger management as very to extremely helpful. Additionally, analyses comparing pre- and post-intervention scores revealed significant improvements in teen internalizing behaviors and self-reported depression, as well as parental depression and parent-teen conflict. Although these preliminary findings indicate considerable promise, a randomized controlled trial (RCT) was necessary to distinguish the effects of TOPS from recovery and developmental influences and to identify who is most likely to benefit from this treatment. The goal of the current project, therefore, was to conduct a RCT to assess the efficacy of TOPS. If TOPS was shown to be efficacious, it could be readily disseminated throughout Ohio to improve adaptation following TBI in adolescence.

The Current Project

The proposed project extended an RCT of TOPS supported by the National Institute on Disability and Rehabilitation Research, by recruiting additional participants. The project was consistent with Priority 3-B (Rehabilitation): “Projects that focus on risk factors identified or interventions performed in the EMS and/or acute care settings that affect the immediate post hospital period with emphasis on discharge planning and solid linkages to needed community services or access to rehabilitation services”.

The overarching goal of the study was to examine the efficacy of TOPS in improving both teen and family functioning following TBI. We employed a between-groups randomized treatment design with repeated measures pre-treatment and immediately post-treatment. The two treatments were: a) usual medical care plus access to internet resources regarding TBI (IRC), and b) usual medical care plus Teen Online Problem Solving (TOPS). Treatment outcomes included adolescent emotional/behavioral problems and social competence. Parent/family outcomes included injury-related stress and burden, caregiver adjustment, and caregiver-child interactions. The main study hypotheses were twofold:

1. Adolescents in the TOPS group were predicted to display greater social competence and fewer behavioral problems at the post-intervention assessment than adolescents in the IRC group. Given the wide range of emotional and behavioral issues following pediatric TBI, we chose several parent- and self-report measures to assess differences in adolescent behavioral adjustment¹¹⁻¹², EF skills¹³, and social competence¹⁴.

2. Families receiving TOPS were expected to experience less injury-related burden, parental psychological distress, and parent-child conflict at the post-intervention assessment than families in the IRC group. The TOPS intervention was expected to lead to more positive parent and family outcomes through their involvement in the intervention, as well as through changes in the adolescent’s functioning. We assessed improvements in parent stress¹⁵, depression¹⁶, and psychological functioning¹⁷ as well as changes in parent-teen conflicts¹⁸.

Over the course of the project, 42 families were recruited into the TOPS RCT at Nationwide Children's Hospital in Columbus, OH and Cincinnati Children's Medical Center in Cincinnati, OH. The children lived up to 3 hours from the participating hospitals, thus giving the project broad regional impact. The most significant challenge for the study was difficulty contacting families by mail or telephone to determine if they would be interested in participating. The addresses and telephone numbers that were available in the hospital systems were often out of date, and an increasing reliance on cell phones and elimination of landlines made it difficult to reach families in that event. This hampered recruitment at times. Despite this challenge, however, we recruited the desired number of families in the planned time frame.

Analysis of Findings

Participant ratings of TOPS ease of use, satisfaction, and helpfulness were uniformly high. All teens and 90% of parents rated the website and videoconferences as moderately to extremely easy to use. Moreover, 100% of participating teens rated the overall website content and training in problem-solving skills as extremely helpful. Likewise, 100% of parents rated the overall content as extremely helpful. In rating the quality of their experience, teens reported feeling moderate to high levels of motivation and support.

Consistent with hypotheses, both parents and teens receiving the TOPS intervention reported significantly greater improvements in teen executive function skills and behavior than those in the IRC group. Effect sizes were moderate to large in magnitude. However, parent and teen perceptions of the nature of these improvements varied, with parents in the TOPS group reporting greater improvements in the teen's emotion control, planning and organization, and internalizing symptoms than those in the IRC. Conversely, teens receiving TOPS reported greater improvements in inhibition, organization of materials, and externalizing symptoms than those in the IRC group. Additionally, parents but not teens receiving TOPS reported significant reductions in parent-teen conflicts. These findings suggest that TOPS and other problem solving interventions may be effective in reducing emerging executive dysfunction and behavior

problems following TBI in teens. However, the findings also underscore the need to consider differences in parent versus teen perceptions of functioning and relationships when evaluating treatment outcomes in this population.

Conclusions

No previous RCT has addressed the unique psychosocial needs of adolescents with TBI and their families. TOPS reflects an innovative integration of cognitive-behavioral and cognitive neuroscience theory, efficacious treatment strategies, and the emerging technology of the World Wide Web.¹⁹⁻²² The use of online technology has the potential to provide resources to hard-to-reach populations and significantly reduce both physical and psychological barriers to care. The project provides critical information about: 1) the efficacy of online interventions following adolescent TBI and 2) the types of families and children most likely to benefit from this type of approach. The investigation represents the logical continuation of Dr. Wade's work developing and testing theoretically-grounded interventions for pediatric TBI. It lays the foundation for subsequent investigations of the efficacy of this approach when translated to clinical settings. The results from the proposed project could provide knowledge, skills, and support to families of adolescents with TBI throughout the state of Ohio at a relatively low cost. The treatment holds particular promise for vulnerable and hard-to-reach populations in central and southern Ohio who face substantial barriers to treatment (e.g., distance, cost, stigma).

Dissemination

We have identified a variety of avenues for dissemination to ensure that they reach the entire range of target populations (consumers, clinicians, researchers and educators). First, we will present the findings in a wide variety of venues, including national and international meetings of educators, rehabilitation specialists, and psychologists. Preliminary findings have already been presented at the meetings of the American Psychological Association and the Australian Society for the Study of Brain Impairment. Findings will also be presented at local and national meetings of patient and family advocacy groups. The project has already been presented at the annual

meeting of the Ohio Brain Injury Association. Descriptions of the intervention and the results of the clinical trial will also be prepared for publication in peer-reviewed medical and psychological journals. We will also distribute our findings to schools, rehabilitation facilities, and policy makers via newsletters and a website. The final phase of dissemination would involve providing technical assistance on the implementation of the intervention to health care providers and advocacy groups, thereby facilitating more widespread utilization among families of children who have experienced traumatic brain injury. Dr. Wade has already successfully disseminated her preliminary work in this fashion with interested individuals. Additionally, she recently received a Rehabilitation Research and Training Center grant from the National Institute of Disability and Rehabilitation Research that will involve a significant dissemination component, as well as further research on innovative, web-based interventions designed to foster the recovery of children with TBI and their families.²³⁻²⁴

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