Cost Effectiveness of Virtual Reality Graded Exposure Therapy with Physiological Monitoring for the Treatment of Combat Related Post Traumatic Stress Disorder

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Abstract. Virtual Reality Graded Exposure Therapy (VRGET) is an effective treatment for combat-related PTSD. We summarize the outcomes of a VRGET pilot study with 12 participants who completed one to multiple combat tours in support of the War on Terrorism and who were subsequently diagnosed with combat-related PTSD. Details of the collaborative program amongst the Virtual Reality Medical Center (VRMC), Office of Naval Research, the Naval Medical Center San Diego (NMCSD) and the Navy Hospital Camp Pendleton are discussed as is the VRGET outcomes of significant reductions in PTSD symptoms severity. We also described the estimated cost-effectiveness of VRGET for the treatment of combat-related PTSD, as contrasted to Treatment as Usual (TAU) for combat-related PTSD.

Keywords. Virtual Reality Graded Exposure Therapy (VRGET), physiological monitoring, Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), Post-Traumatic Stress Disorder (PTSD)

The opinions expressed are the private ones of the authors and should not be considered approved or representative of the Navy Medical Department, the Office of Naval Research or the Department of Defense.
**Introduction**

In the face of mounting public concern over post-deployment health care issues confronting Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF) veterans, a Department of Defense (DOD) Task Force [1] a Presidential Commission [2] and an independent review group [3] were convened to examine the care of the war wounded. Both the DOD Task Force Report and the Report of the President’s Commission discovered that 11-25% of OIF and/or OEF veterans have been diagnosed with PTSD and both of these reports recommended that VA and DOD should aggressively prevent, develop early intervention strategies and treat PTSD [1-3]. Early treatment intervention for PTSD has been endorsed in other reports as well [4,5]. Disappointedly, several studied have documented that the rate of PTSD would be higher among troops who have been to Iraq more than once [5,6] and that PTSD, secondary to combat tours in Iraq, has been rated as the second leading cause of combat injury [1-3].

Because the PTSD diagnosis comprised a complex of symptoms, a combination of treatments is recommended [7]. A meta-analysis review of traditional PTSD psychotherapy (i.e., various forms of cognitive Behavioral Therapy, Stress Inoculation Training, Prolonged Exposures, EMDR and Reprocessing, etc.) reported only 44% of all those who entered treatment were classified as improved at the end of the treatment [8]. Milliken et al. [4] reported that soldiers, who were diagnosed with PTSD, and who received 3 or more sessions of mental health treatment had a 37% improvement rate; this 37% treatment response was not inconsistent with the response rate documented in other PTSD treatment studies [9,10]. Milliken et al. [4] concluded that, “in the context of the recent DOD task force finding, the 37% treatment response rate for PTSD is not optimal in military health clinics because soldiers are either not receiving a sufficient number of sessions or the treatment provided is ineffective.” PTSD treatment with anti-depressant medications, such as selective serotonin reuptake inhibitors, infrequently results in patients achieving more than a 40% reduction in their Clinician Administered PTSD Scale (CAPS) scores, and most patients will still meet criteria for PTSD at the end of an adequate treatment trial [11]. In terms of treatment efficacy, some studies have suggested that combat-related PTSD may be more refractory than PTSD secondary to other traumas [12].

Recently, The Institute of Medicine concluded that only exposure therapy was recommended as the treatment for PTSD [13]. Virtual Reality Graded Exposure Therapy, with Physiological Monitoring (VRGET) is a promising exposure therapy that has been documented as an exceptional treatment for anxiety disorders and specifically for PTSD [7,14-18]. Wood et al. [17] utilized VRGET with participants diagnosed with PTSD secondary to their combat tour or tours due to the War on Terrorism. All warriors completed 10 sessions of VRGET and by the end of treatment, measurable reductions in PTSD, depression and anxiety were documented. Recently, Wood & Wiederhold [18] reported the treatment outcomes of 12 male participants, diagnosed with combat-related PTSD, who completed the 10 week VRGET Pilot study at Naval Medical Center San Diego (NMCSD) and Navy Hospital Camp Pendleton (NHCP). By the end of 10 sessions of VRGET, these participants experienced significant reductions in PTSD and depression and measurable reductions in anxiety.

Using previously published studies that have documented the effectiveness of traditional psychotherapy or Treatment as Usual (TAU) to treat combat-related PTSD [4,7-11] and the report [18] of the effectiveness of VRGET in successfully treating
combat-related PTSD, this study was designed to report the estimated cost effectiveness of VRGET versus TAU care for participants diagnosed with combat related PTSD. The VRGET participants received their VRGET mental health care at either NMCS or NHCP.

1. Method

1.1 Participants

Twelve male volunteers met the DSM-IV-TR criteria for chronic PTSD [19] and these participants also met the study requirements for enrollment in the pilot phase of the VRGET study (see Table 1). All of these participants were members of the United States Navy or United States Naval Reserve. All but one of our participants were prescribed and were actively taking psychotropic medication prior to and following their enrollment in the Pilot VRGET study; all of our participants consulted with their Navy psychiatrist at least twice during the study period.

These 12 participants were originally diagnosed with PTSD, by a Navy psychiatrist, between January 2004 and August 2008; all of our participants initiated VRGET since March 2006. As part of the treatment protocol, VRGET was typically delivered over a 10 week period and treatment sessions each lasted 90 – 100 minutes. Each VRGET session was typically conducted one to two times each week by one of the authors (DPW) or by another civilian clinical psychologist.

Following the completion of their VRGET, three of our participants received a Medical Discharge secondary to their PTSD and co-morbid medical diagnoses, one participant received an Honorable Discharge due to his retirement from the Navy following 20 years of active service, one active duty and three Navy Reserve participants received Honorable Discharges upon their having reached the end of

<table>
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<th>RANK (a)</th>
<th>Military Specialty</th>
<th>AGE</th>
<th>Combat Tours</th>
<th>mTBI</th>
<th>PSYCH MEDS</th>
<th>MED BOARD</th>
<th>STATUS (c)</th>
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<td>Active Duty/Deployed: Iraq</td>
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</table>

Table 1. Demographic, 10 VRGET sessions completed and current status of the VRGET pilot participants (N = 12); (a) USN: United States Navy; USNR: United States Naval Reserve; (b) mTBI: mild Traumatic Brain Injury; (c) HD: Honorable Discharge; EOS: end of obligated service
enlistment or at the end of their recall to active duty and four of our participants have continued on active duty. Two of the participants, who remained on active duty, were subsequently re-deployed to Iraq and both have recently returned from their respective deployments.

1.2. Procedure

The Procedure has been previously described [16,17].

1.3. Clinical Measurement Instruments

The Clinical Measurement Instruments have been previously described [16,17].

1.4. Equipment

The equipment has been previously described [16, 17].

1.5. Treatment

The Virtual Reality Graded Exposure Therapy (VRGET) has been previously described [16,17].

1.6. Training Cost Assessment

The estimated cost of providing 10 VRGET sessions (i.e., approximately 15 hours of VRGET) to a participant, diagnosed with PTSD, and 4 hours of pre- and post-treatment assessment, involved approximately 19 hours of a clinical psychologist’s time is assessed at $2,100.00. For the purpose of this study, the cost of the VRGET 3-computer system, the VRMC software and the cost of training a clinical psychologist in Exposure Therapy and VRGET were not factored in as treatment costs.

Levy, Rattelman, Grefer et al [20] reported that Hospital Corpsman/Dental Corpsman (HMs/DTs) training represents a significant investment for the Navy. In terms of student costs alone, the Navy spends about $20,000 to train a general duty Hospital Corpsman. Further, Levy et al [20] assumed the following: (a) that all HMs/DTs attended boot camp and Basic Corpsman Training (i.e., A-school); (b) all HMs/DTs attend Field Medical Service School/Combat Medic Training (FMSS); and (c) the cost of recruiting a sailor was fixed at $1,000 per recruit. Hence, the minimal cost of training this Hospital Corpsman is $21,000. According to Levy et al [20], the cost of graduate medical education (GME) for a physician resident is $104,000 per year; two years of GME equals a training cost, to the Navy, of $208,000.

Even though all of the VRGET participants were not Corpsmen, we have assumed that the basic training costs for the eleven enlisted participants were similar and

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1 personal communication from Dr. Mark Wiederhold, February 13, 2009
2 Student cost is estimated to be compensation and PCS (moving costs associated with a change in duty station), calculated at the average student’s Paygrade and prorated for the course length.
equaled a training cost of $231,000 (11 X $21,000). Combining the enlisted training cost of $231,000 with the GME training cost of $208,000, for the Medical Officer who completed VRGET, the total estimated training cost, to the Navy for the 12 participants who successfully completed VRGET (see Table 2), is $439,000.00.

Table 2. Estimated Training Cost (ETC) Savings due to VRGET at NMCSD and NHCP versus Treatment As Usual (TAU) for combat-related PTSD (N = 12) and ETC Savings for 5 Clinical Psychologists to treat 200 warriors with VRGET.

<table>
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<tr>
<th>ETC for 12 VRGET Participants</th>
<th>ETC Savings with TAU with 44% Treatment Effectiveness</th>
<th>ETC Savings with VRGET with 75% Treatment Effectiveness</th>
<th>ETC Savings: VRGET vs. TAU</th>
<th>ETC Savings of VRGET vs. TAU minus Cost of Clinical Psychologist (i.e., $21,600.00)</th>
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<td>$439,000.00</td>
<td>$193,160.00</td>
<td>$329,250.00</td>
<td>$136,090.00</td>
<td>$114,490.00</td>
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2. Results

The VRGET participants’ clinical levels of PTSD and Depression significantly reduced and their level of anxiety measurable reduced from their pre-treatment assessment to their post-treatment assessment (18, see Figure 1). More specifically, at the end of 10 sessions of VRGET, 75% of the participants’ PCL-M scores had reduced, with 75% of our participants’ PCL-M scores equaled 49 or lower and/or they were assessed, by the evaluating psychiatrist (RLM), as not any longer meeting the DSM-4 [19] criteria for PTSD. Referencing the Estimated Training Costs for the 12 VRGET participants, the 75% VRGET effectiveness level equals an estimated training cost savings of $329,250.00 versus the estimated training cost savings of $193,160.00 for PTSD TAU (see Table 2). Hence, the estimated training cost savings of VRGET versus TAU, for PTSD, minus the cost of the clinical psychologist, is estimated to be $114,490.00 (See Table 2).

Figure 1. Results of Pre-TX and Post-TX PCL-M*, PHQ-9* and BAI Assessments (N = 12).
In this era of reduced DOD mental health care resources and increased mental health care demand, secondary to the increasing number of warriors diagnosed with combat-related PTSD, there is an increasing emphasis on effective psychotherapeutic treatment that is cost effective.

The process of care for the combat warrior, diagnosed with PTSD, is being scrutinized in terms of the effectiveness of mental health care and the empirical support for the treatment that is being used [4,6–12]. The cost of mental health care for PTSD is high because of the long duration of care, the fact that less than 44% of those treated experience a measurable reduction in their PTSD severity and there is a lack of trained clinicians [1–3,6-12]. It is hoped that efforts to develop more effective PTSD treatments, such as VRGET, would ultimately result in more effective standardized clinical pathways and the development of guidelines for the appropriate use of the more effective standardized clinical pathways.

This study matched the clinical outcome of 12 volunteer participants, who received VRGET for combat-related PTSD at two Navy Hospitals (NMCSD & NHCP), with their estimated training cost data. A cost simulation analysis showed that the estimated measurable reductions in training costs, as a result of VRGET, could lead to substantial estimated training cost savings as compared to replacing those warriors who would otherwise have been medically discharged from the Navy due to the severity of their PTSD. With this study’s VRGET pilot participants, after subtracting the cost of the treating clinical psychologists, an overall savings of $114,490.00 for VRGET vs. TAU was documented.

Importantly, the estimated cost savings of training, due to VRGET, did not include the recruiting costs, the actual cost of a recruit completing recruit training, the cost of housing allowances, medical care costs, advanced training costs or the inherent costs secondary to attrition (i.e., how many individuals have to enter recruit training, graduate from recruit training, start and complete “A” school in order to have a qualified Corpsman, Seabee or SEAL). Lastly, the cost of the VRGET hardware and computers and the cost for a clinical psychologist to receive VRGET training were not factored into the cost simulation.

Caution needs to be exercised in considering the results of this cost simulation analysis due to the small number of the VRGET pilot participants, the fact that these pilot participants were treated at two Navy Hospitals by two clinical psychologists and the fact that the TAU studies referenced [6,8-12] were not exhaustive. Further, the absence of a randomized VRGET study and the inherent possibility that our 12 volunteer participants’ positive VRGET response was the result of a self-selection bias and this selection bias could be a reason for the reported therapeutic outcomes need to be considered. Hence, as recommended by Milliken et al [4], randomized trials need to be conducted evaluating treatment of warriors diagnosed with combat-related PTSD. Such a randomized study, comparing VRGET to TAU, is currently underway at NMCSD and NHCP. We must also caution that there are obvious limitations to the generalizability of these results to other PTSD treatment populations at other medical centers, military, Veterans Administration or civilian.
Acknowledgment

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References