Leveraging Technology for Psychological Health and Traumatic Brain Injury

Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury

February 2011

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Executive Summary

Background

More than 1.5 million U.S. military service members have deployed in support of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), with many serving multiple tours of duty.[1] Since the start of OEF and OIF the incidence of traumatic brain injuries (TBIs), particularly from blasts,[2] among deployed service members has risen substantially.[3] Furthermore, psychological health conditions, such as post traumatic stress disorder (PTSD), anxiety, and depression, have been up to three times as likely among soldiers returning from deployment as among soldiers with no previous OEF/OIF experience. Suicides among U.S. military personnel have reached an all-time high. [4]

During that same period of armed conflict, there has been an exponential leap in the advancement and societal use of technology. Currently, 258 million Americans use the Internet with approximately two billion people online across the globe. Within the next five years, more than 95 percent of U.S. households will have personal computers, 195 million Internet users will be connected wirelessly, and more than 340 million cell phones will be in use.[5]

ADVANTAGES OF TECHNOLOGY

Many of those technologies have significant potential for supplementing, or even replacing, conventional approaches to psychological health and TBI prevention, resilience, treatment, outreach, rehabilitation, and reintegration programs. The Internet provides the umbrella connectivity for websites, including social networks, gaming, virtual worlds, e-mail, telehealth, many mobile device features and functions, and other emerging technologies. These technologies share common advantages over conventional approaches to psychological health by promoting psychological wellness and resilience. By providing 24/7 "always-on" availability, they circumvent such scheduling difficulties as clinic hours. Because they can be accessed from any location with sufficient Internet connectivity, they bypass transportation obstacles and extend outreach and care to remote or underserved areas. They can confer a measure of anonymity and privacy, thereby reducing stigmatization.   Additionally, they can conveniently proffer a high volume of richly diverse and tailored information and functionality to large numbers of users simultaneously and/or on demand. Mobile devices, such as smartphones, have the added advantage of convenient portability and the availability for free or inexpensive download of hundreds of thousands of software applications (commonly called "apps"), including many health-related apps.

NATIONAL CENTER FOR TELEHEALTH AND TECHNOLOGY (T2)

The Defense Department's National Center for Telehealth and Technology (T2)[6] researches and develops innovative technology applications for military psychological health and TBI; suicide surveillance and prevention; online behavioral health tools; and telepsychological health. Those technologies currently in active development or under review encompass the Internet and World Wide Web (Web); video and telehealth; email; social networking and online communities; mobile access and wireless platforms; electronic gaming; and finally, virtual reality and online virtual worlds.

T2: EXAMPLES

Websites

T2 developed and maintains the Defense Department's primary website for redeployed service members, their families, and providers. *Afterdeployment.org* contains 18 core topic modules and 29 online self-assessments. Each module includes one or more topical self-assessment scale; video-based "personal stories" from service members and their families; interactive workshops; and comprehensive libraries. *Afterdeployment.org* also includes community forums; expert blogs; a provider portal; easy access to hotlines and chat functions with qualified staff; links to social media; RSS feeds; a provider locator; podcasts; a quarterly newsletter; and links to external resources, polls, health tips, and cognitive exercises. The site provides links to Facebook, Twitter, and other social media, and a corresponding *afterdeployment.org* channel on Facebook has been launched.

Email

The T2 *Caring Letters* project is a suicide prevention outreach program that sends brief, personalized email messages containing expressions of care and reminders of available treatment to patients at high risk for suicide after leaving inpatient psychiatry care. The goal of *Caring Letters* is to reduce suicide attempts and mortality, especially among patients who do not seek follow-up care.

Mobile Access

A mobile, smartphone version of T2's *afterdeployment.org* site is currently being constructed, and at least 26 apps are under development or being evaluated at T2, including apps for targeting mood-monitoring (T2 Mood Tracker), stress management (Breathe2Relax), and brief vital signs for psychological health and TBI following critical incidents in deployment settings (T2 Mobile Screener). Beyond T2, the Army's mCare research program[7] sends daily text messages to wounded warriors' mobile phones to see if frequent contact will promote home recovery.

Telehealth

Telebehavioral health uses telecommunications technologies to increase access to and enhance the delivery of psychological health and TBI (PH/TBI) health care from a distance or remotely. T2 and Department of Veterans Affairs (VA) collaborators will shortly begin a research study to demonstrate the safety of in-home telebehavioral health care treatment for depression in warrior and veteran populations. T2 has also partnered with the University of Washington to study the effectiveness of individualized, scheduled telephone counseling for self-management to address the physical, cognitive, and psychological symptoms associated with mild TBI and PTSD. Finally, T2 and Tripler Army Medical Center are investigating the utility of modified and telehealth-equipped shipping containers to deliver PH/TBI telebehavioral health care to service members.

Virtual Reality

At the cutting edge of technology for psychological health, virtual reality (VR) is showing potential for the treatment of PTSD. Virtual reality uses computers and peripherals, such as head-mounted audio-video displays and motion tracking devices, to deliver information through sight, hearing, touch, and sometimes smell, in a virtual environment.[8] Virtual reality has proved especially effective in delivering exposure therapy for PTSD,[9] and comprises a substantial part of T2 activities. T2 recently tested VR exposure for treating active duty soldiers with combat-related PTSD symptoms. Sixty-two percent of patients reported a reliable change in symptoms as a result of VR exposure.[10]

THE FUTURE

If trends persist, the future of technology for addressing military psychological health and TBI seems limitless. Technology will continue to increase easy access to information and care through a variety of ever-more convenient and mobile conduits. Popular socio-recreational activities will be further leveraged for health care purposes; for example, digital games, graphic novels, and audio and video podcasts may play a part in behavioral health. Already, the iPhone and other portable devices offer handheld video-conferencing functionality that has obvious potential for therapeutic telehealth. Physiological sensors integrated into mobile technology will afford providers real-time patient feedback, while animated representations of human hosts, or "avatars," and three-dimensional virtual reality will provide a more realistic and immersive therapeutic environment for patients. T2 and its collaborators will continue to explore the multiplicity of new and emerging technologies that best serve the evolving psychological needs of the U.S. military.

Introduction

"As a *global* force with global responsibilities, we shoulder a heavy burden. While we remain the most capable military in the world, the stress on our forces and the strain on our families are real. Deployed forces from our active and reserve components and National Guard will remain high, exacerbating these concerns even further… Our core responsibility is to win wars while caring for our people and their families. They are the heart and soul of our formations, our fleets, and our air expeditionary wings, and our incredible fighting spirit. As a Nation, we have a solemn obligation to support fully, *across the spectrum of need*, our servicemen and women, standing and fallen, and their families. As leaders, we must ensure that all receive the care, counseling, training, and financial support they need to become self-sufficient and lead productive and fulfilling lives. We have not yet done enough here, particularly in research and care for the unique wounds of our current wars. We must accelerate our efforts while connecting with community based efforts throughout America. Our culture must value and support a *continuum of care* that lasts for a lifetime, and encompasses military members, retirees, and their families." [Italics added] **M.G. MULLEN, Admiral, U.S. Navy; CJCS Guidance for 2009-2010; 21 December 2009.**

The U.S. military has been in almost continuous armed conflict from 2001 through the ongoing Operation Iraqi Freedom (OIF) in Iraq and Operation Enduring Freedom (OEF) in Afghanistan. The resulting impact of deployment and combat on the psychological well-being of U.S. service members has been considerable. Increased rates of traumatic brain injury (TBI), post-traumatic stress disorder (PTSD), depression, anxiety, substance abuse, redeployment psychosocial adjustment, and suicide, have been well documented. U.S. military combat activities and their consequences on behavioral health and TBI have coincided with a quantum leap in technological advances and a social revolution in the use of personal technology. Many of those technologies offer great promise in facilitating prevention, resilience, treatment, outreach, rehabilitation, and reintegration programs for psychological health and TBI.

The National Center for Telehealth and Technology (T2)[6] is a component of the Defense Department's Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE). T2 serves as the principal Defense Department coordinator in such areas as innovative technology applications, suicide surveillance and prevention, online behavioral health tools, and telepsychological health. As such, it plays a primary role in researching and developing technologies to address the psychological health needs of service members and their families.

 In this paper we will document the extent of psychological health disorders and TBI in the U.S. military, and the advantages a number of technologies have in addressing those issues. We will detail the pervasive penetration of personal technologies in everyday life, and we will describe some of the technologies that T2 and its collaborators are exploring to help service members and families facing psychological health and TBI issues. Finally, we will speculate briefly about the future of technology in military psychological health care and consider the next steps for T2 and its associates.

Psychological Health Disorders and TBI in the U.S. Military

PTSD

Estimated rates of PTSD among service members returning from deployment over the last decade have been varied but are clearly substantial. Service members deployed to Iraq in the first two to three years

of the new millennium screened positive for PTSD at rates of 18 percent and 19.9 percent, respectively, while 11.5 percent of those deployed to Afghanistan during the same period (i.e., before the more recent escalation of fighting) screened positive.[11] Analyses of Army and Marine service members[12] shortly after returning home found PTSD rates of 9.8 percnt of those deployed to Iraq and 4.7 percent of those deployed to Afghanistan. A follow-up population-based study which assessed service members for PTSD approximately six months after returning from deployment to Iraq revealed that nearly 17 percent screened positive.[13] Most recently, 7.3 percent of Active Component and 11.3 percent of National Guard service member have been found to meet a strict screening definition of PTSD 12 months after deployment.[14] Perhaps of most concern is the prospect of veterans facing long-term debilitation by PTSD. Nearly 16 percent of OIF and OEF veterans who sought treatment at Veterans Affairs (VA) facilities within a four-year window met criteria for PTSD.[15] The lifetime prevalence of functional impairment by PTSD among Vietnam veterans experiencing combat has been conservatively estimated at 18.7 percent.[16]

TBI AND COMORBIDITY

The incidence of TBI for service members has increased significantly since the start of OIF/OEF.[3] Most injuries are blast-related with almost half of all injuries involving the head.[2] Early estimates suggest that almost 23 percent of brigade combat teams show clinician-confirmed TBI during post-deployment screenings.[17] A complication in the management of TBI due to injuries sustained in battle is the frequent co-occurrence of PTSD and other anxiety and mood disorders. Most studies of TBI in the civilian population cite a prevalence rate of about 10-30 percent for PTSD.[18] There are also many individuals with TBI who have significant PTSD symptoms, although they do not meet all the criteria for PTSD.[19] Major depression is often not considered a combat-related injury; however, analyses suggest that it is highly associated with combat exposure and should be considered as part of the spectrum of post-deployment mental health consequences.[20] An increased risk for depression has been associated with TBI in both civilian and military populations for all levels of brain injury.[2, 21]

SUICIDE

Since the beginning of OIF/OEF combat operations, an upward trend of suicides among service members has also emerged, and U.S. military personnel are taking their own lives in the largest numbers since formal suicide records began in 1980.[4] At least 164 Army soldiers killed themselves in 2009, an increase for the fifth year in a row, and numbers for Marine Corps, Navy, and Air Force have also increased considerably. The 2009 Army numbers represent a rate of more than 20 per 100,000, higher than the adjusted civilian rate; it is the highest Army suicide rate in nearly three decades.[22] As with PTSD the problem is not confined to active service personnel. In 2007, the suicide rate among OIF and OEF veterans between the ages of 20 to 24 was nearly 23 per 100,000, significantly higher than non-veterans in the same age bracket.[23]

Integrative Medicine and Technology

Both the physical and the psychological well-being — the broader health of the service member — are of paramount importance to the U.S. military. Psychological health and its repercussions on quality of life must be regarded as essential as physical vitality in military medicine, and more broadly, in all military operations. Psychological health and physical health are inextricably linked. Physical debilitation frequently has repercussions on mood and emotional state. But distressed emotional states also generate additional somatic problems, such as sleep difficulties, fatigue, and pain, which in turn can

confound the conventional diagnosis and treatment of physical symptoms.[24] In 2007, the U.S. Institutes of Medicine (IOM)[25] published a report on cancer care that had widespread influence beyond the confines of oncology. In "Cancer Care for the Whole Patient: Meeting Psychosocial Health Needs," the IOM Committee recommended a standard of care that included "identifying each patient's psychosocial health needs," and "linking the patient with psychosocial services." The Committee defined psychosocial health services thus: "….psychological and social services and interventions that enable patients, their families, and health providers to optimize biomedical health care and to manage the psychological/behavioral and social aspects of illness and its consequences so as to promote better health." For more than two decades, researchers have advocated a broad spectrum of health outcome domains labeled "quality of life," which typically encompass physical, psychological, and social functioning, as well as symptomatology and sometimes spirituality.[26] Clinical trials, treatment metrics, and even electronic media commonly incorporate quality of life outcomes.[27]

Recent years, however, have seen a burgeoning movement in medicine towards addressing the "whole patient" by embracing a more holistic model of integrative care to varying degrees. Integrative medicine practices range from a relatively common and modest incorporation of biomedical and psychosocial issues to a supplementation of conventional medicine with alternative or complementary treatments, such as herbal medicine, acupuncture, massage, biofeedback, yoga, and stress reduction techniques. In recent years the military has made tentative inroads into alternative or holistic medicine to serve as treatment interventions for psychological (and physical) trauma. For example, the iRest Yoga Nidra protocol was assessed in 2006 as an adjunctive therapy for PTSD at the Walter Reed Army Medical Center (WRAMC) (available at http://clinicaltrials.gov/show/NCT00269490) and has since been incorporated into the weekly Deployment Health Clinical Center treatment program for soldiers with PTSD at WRAMC. Furthermore, it appears that individual military personnel have turned to alternative medicines at approximately the same rate and in the same demographic as the general population.[28]

Health practices that integrate the physical and psychological ultimately have applicability beyond the medical setting to peers and line leaders alike across all phases of deployment. Technology offers unique versatility of content and functionality through multimedia capabilities that are widely and easily accessed. Consequently, technology provides an ideal vehicle for integrating the diverse physical and psychological issues encountered by U.S. service members into a comprehensive and holistic resource for warriors and veterans in need.

Technology for Behavioral Health Care Delivery

When Operation Desert Shield was launched in 1990, there were just 1.8 million U.S. Internet users; these represented 85 percent of total users worldwide. By the start of OEF in 2001, that number had rocketed by nearly two orders of magnitude to 135 million U.S. users, but represented just one-third of worldwide users as the Internet spread internationally. By the time of the surge into Iraq in 2007, the number of U.S. Internet users had almost doubled again to more than 220 million (15 percent of world users). The 2010 escalation of U.S. troop involvement in Afghanistan as part of OEF saw the rate of U.S. increase slowing, but nonetheless 258 million Americans used the Internet in 2010, while there were approximately two billion people online across the globe. Numbers are projected to continue rising over the next four to five years internationally by at least another half-billion.[5] If current trends continue, market research projects that by 2015 in the U.S. alone, more than 95 percent of households will have personal computers, 195 million of 285 million Internet users will be connected wirelessly, and more than 340 million cell phones will be in use.[5] Figures on the percentages of U.S. service members using personal technology are scarce. However, our own anecdotal experience at a large joint Army-Air Force base suggests that technology use among the predominantly young, male service population closely mirrors that of the general population.

Early driving forces behind the growth in Internet use included factors such as the proliferation of email use; the introduction of the Web and web browsers along with an explosion in available content; the availability of inexpensive personal computers; and the advent of broadband connectivity.[5] However, in the last few years, those driving forces have changed. Wireless access and mobile technology, social networking, entertainment, and especially multi-function handheld devices, such as smartphones, media players, and the like, have largely taken precedence.

Twenty-first century service-delivery models must take into account the military's fast-paced operational tempo. Multiple deployments are nearly the norm, resources are limited in rural settings, and transportation to nearby clinics and Military Treatment Facilities (MTFs) can be a barrier. Through August 31, 2010, 27 percent of more than two million OIF/OEF service members deployed at least two times and 10 percent of OIF/ OEF service members deployed at least three times.[29] In this environment the increasingly ubiquitous electronic media represent convenient and wide-reaching vehicles for delivery of health information and care. It is critical, therefore, that researchers, providers, and therapists take full advantage of those media to better address military PH and TBI issues, and thereby contribute to the integrative health of U.S. service members. Given the astounding penetration of the Internet, social networking, mobile multimedia/communication, and other technology into the everyday lives of service members and civilians alike, the onus is on specialized Defense Department research and development organizations, such as the T2, to identify how to optimize primarily personal electronic devices to best provide mental health care and information. To that end, researchers, including T2 and collaborators, are pursuing a wide range of activities designed to leverage the most promising technologies.

The Internet/Web

ADVANTAGES

The Pew Internet and American Life Research Center[30] estimates that 66 percent of American adults now have a broadband high-speed Internet connection at home.[31] The Web has revolutionized the availability of health information and the "empowered medical consumer"[32] has become commonplace in provider offices.[33, 34] Technology applications offer numerous advantages for promotion of wellness and resilience. Through bypassing of common barriers such as transportation and scheduling difficulties, and by virtue of 24/7 "always-on" availability, technology facilitates access. Individuals in need can acquire information at all times of the day and night and are not confined to conventional business hours and to global time zones. Those who use technology to access behavioral health resources can exercise greater control over when and where to utilize those resources, no longer needing to wait until the next appointment (which may be weeks away due to staffing shortages or scheduling problems). Furthermore, the Internet can extend outreach and care to remote or underserved areas, a facility especially pertinent to redeploying National Guard and Reserve members returning to their civilian lives and locations.

Technology can additionally better manage high-volume needs than the finite resources characterized by most clinic settings. The Internet also confers a degree of anonymity to a user who may have privacy concerns. Since resources obtained via websites and mobile applications can be downloaded privately, technology supports confidential, non-stigmatizing use. In the military, where stigma presents a considerable barrier to seeking mental-health care,[35, 36] anonymity can be especially vital. Stigma is a concern for many who serve. Some service members believe that getting help for a behavioral problem is a sign of personal weakness. Others believe that getting help will result in a negative mark or cause the perception among command and battle buddies that duties cannot be managed. Still others believe that they will be labeled with a mental illness. In the U.S. military, estimates suggest that as few as 23 percent to 40 percent of those diagnosed with psychiatric disorders seek treatment.[37] Those whose responses meet screening criteria are generally about two times as likely as those whose responses do not to report concern about being stigmatized and about other barriers to accessing and receiving mental health services.[11] Consequently, service members may be more willing initially to visit an anonymous website than to call a provider.

Finally, the richness and variety of multimedia accessible via the Internet make websites and other venues usefully interactive, attractive, and engaging, although access factors other than availability impact usefulness.[38] Content across the spectrum of technology tools and devices can be versioned across several platforms, and allows the user to pace their 'dosage' of materials.

EXAMPLES

In August 2008, T2's Defense Department website *afterdeployment.org* became available to the public. Originally conceived to include 12 core topics and 12 self-assessments, by March 2010 the site had expanded to 18 modules[1] and 29 assessments.[2] Each module includes one or more topical self-

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[1] Post-traumatic stress, depression, general life stress, families and friendships, work adjustment, adapting to physical injury, anger, sleep, substance abuse, families with kids, spirituality, health and wellness, anxiety, military sexual trauma, stigma, mild traumatic brain injury, tobacco cessation, and resilience.

assessment scale, video-based "personal stories" from service members and their families, interactive workshops, and comprehensive libraries. Moreover, the site offers community forums; expert blogs; a provider portal; easy access to hotlines and chat functions with qualified staff; links to social media; RSS feeds; a provider locator; podcasts; a quarterly newsletter; and links to external resources, polls, health tips, and cognitive exercises.[3]

The site's plethora of materials, exercises, and other features comprise a comprehensive approach to common conditions and challenges often confronted by service members and their families following a deployment. While many of the site's modules (e.g., post-traumatic stress, depression, substance abuse) provide users with tools to limit the impact of behavioral health conditions (tertiary prevention), inclusion of content *not* focused on psychopathology allows users to tap areas that target personal and emotional growth (primary prevention). Finally, the site's 29 self-assessments provide users with a quantitative means to detect symptoms (secondary prevention). In particular, three of the site's modules (Resilience, Health and Wellness, Spirituality) provide users with enriching skills-development tools.

Resilience Module

The American Psychological Association (APA) defines resilience as "the ability to adapt well in the face of adversity, trauma, tragedy, threats, or other significant sources of stress." Resilience has special currency within the military culture. Including a resilience module on *afterdeployment.org* was recognized as complementary to Defense Department initiatives, as reflected by the service branches' resilience programs: the Army's Comprehensive Soldier Fitness (CSF) program,[39] the Navy/Marine Corps' Combat and Operational Stress Control (COSFC) program,[40] and the Air Force's Comprehensive Airman Fitness Program[41] all aim to support and promote warrior resilience. *Afterdeployment.org's* resilience materials are grouped into the following categories: developing and maintaining relationships (assertiveness, conflict resolution), personal qualities (realistic thinking, optimism, forgiveness, gratitude, generosity, personal values), and targeted skills (goal setting, time management, problem-solving).

Health and Wellness Module

Afterdeployment.org's health and wellness module provides tools to help balance the competing demands of work, family, and leisure. Its various pro-social mind-body topics include time management, positive self-talk, effective communication, meditation and mindfulness, journaling, nutrition, fitness, sleep, and yoga.

Spirituality Module

Spiritually fit people tend to have stronger esteem, better coping skills, and healthier relationships. Unfortunately, deployments can challenge long-held beliefs; for many, the world looks different after facing danger and death. While some individuals gain a stronger faith following trauma, others feel spiritually empty. 'Spiritual fitness' means having a set of beliefs and values that provide guidance throughout life. *afterdeployment.org's* spirituality materials explore the meaning in trauma, survivor guilt,

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[2] Alcohol and Drugs, Anger, Anxiety, Caregiver Stress, Depression, Friendship Scale, Forgiveness, Generosity, Gratitude, Hope, mTBI Symptom Management, Marital Satisfaction, Nicotine Dependence, Optimism, Panic, Parenting Confidence, Perceived Social Support, Physical Injury Resilience, Post Deployment Social Support, Post-Traumatic Stress, Resilience, Satisfaction with Life, Sexual Trauma, Sleep, Spirituality, Stigma, Stress, Work Adjustment, Worry.

[3] For example: "Which best describes why you joined the service? (a) The education or training benefits, (b) I was going nowhere as a civilian, (c) Friends were joining, (d) I was encouraged by my family, (e) The adventure-travel, challenge.

trust, and the challenges that warrior's confront. The spirituality module addresses how stressful or traumatic experiences might affect spiritual fitness and general health by discussing issues of belief and values; connectedness; personal well-being and satisfaction with life; and senses of meaning and purpose.

Video and Telehealth

ADVANTAGES

Seven in 10 adult Internet users now use the Internet to watch or download videos. [42] The increasing capacity of broad-band connectivity to provide audiovisual communications and high-resolution video has important implications for behavioral health care in remote and underserved populations where telehealth and telemental or telebehavioral health may be not only a convenience, but also a lifeline. Telebehavioral health is a broad term that encompasses the use of telecommunications technologies to increase access to and enhance the delivery of psychological or behavioral health care, or, in the military context, PH/TBI health care, from a distance or remotely. Psychological health and TBI telebehavioral health leverages technologies such as computers and the Internet, telephones, mobile devices, and video-teleconferencing (VTC) to improve PH and TBI care for service members and their families. Telebehavioral health care can be delivered synchronously through interactive, two-way, and real-time audio and visual connections or asynchronously where communication occurs in one direction at a time. Telebehavioral health can provide 24/7 care to patients in need; eliminate wait times and travel costs; and potentially reduce stigma when therapeutic interventions are delivered privately in the comfort and convenience of a patient's home. Much of the telebehavioral health focus to date has been on health care delivery using synchronous communications available via VTC units and, more recently, through personal computing devices. A number of studies have shown strong support for the use of telebehavioral interventions for the treatment of depression and PTSD. [43-46] Utilizing these technologies to deliver care synchronously has been shown to be equivalent to traditional in-person care[45-47] and is now covered by many health care insurers, including the military's TRICARE program.[48]

EXAMPLES

The synchronous delivery of health care from a distance can be regarded as meeting current standards of care. T2 and similar organizations are utilizing these proven technologies to focus on innovating where and how care can be delivered.

In-Home Telebehavioral Health Care

Luxton et al[49] recently conducted a review of telebehavioral health studies reported in peer-reviewed journals to provide an overview of safety issues associated with general telebehavioral health care and to evaluate the safety of telebehavioral health care delivered to unsupervised settings. Not surprisingly they identified a limited number of articles assessing safety on these clinically unsupervised settings. However, their review does provide evidence suggesting that telebehavioral health delivered to a patient's home can be safely managed. T2 is using this information as a basis to conduct more extensive evaluations of delivering clinical care from a distance into a patient's home. As a first step T2 is partnering with the Portland VA in early 2011 to conduct a randomized controlled trial (RCT) designed primarily to determine the safety of in-home telebehavioral health care. This study will evaluate in-home telebehavioral health behavioral activation (BA) against in-person BA treatment as an intervention for depression in warrior and veteran populations. Behavioral activation is optimal for testing an in-home TBH model, because there is strong theoretical and empirical support for BA, including on-going telebehavioral health RCTs examining BA in veteran populations. While demonstrating safety is the necessary first step to determining standard of care, this study will also examine patient compliance,

treatment satisfaction, and overall feasibility of this in-home telebehavioral health intervention.

Telebehavioral Health via Telephone

Although use of mobile telephones for relatively new media, such as texting, is endemic, especially among younger adults, voice calling is still the primary use of the phone for most adults.[50] The telephone represents both an old (landline) and new (wireless, Voice Over Internet Protocol) technology that, combined, is still the most ubiquitous communication technology in the U.S. population. Simple voice communication by phone may be a century-old technology, but nonetheless, can deliver effective telehealth psychotherapy.[51] A pertinent example for military utility is the use of telephone voice intervention for mild TBI (MTBI). One self-management intervention successfully tested on civilian MTBI patients at the University of Washington employs individualized scheduled telephone counseling (ISTS). ISTS emphasizes symptom- and self-management to address the physical, cognitive, and psychological symptoms associated with MTBI and (when relevant) co-occurring PTSD, depression and/or anxiety.[52] However, this intervention has never been evaluated with redeployed military personnel presenting symptoms of MTBI. A collaboration between the University of Washington and T2 currently is conducting a randomized controlled trial comparing the effect of ISTS to the effect of usual care alone on MTBI/post-concussion symptom severity in an Army population.[53] A series 12 ISTS phone calls are made to study participants over a six-month period, followed by evaluations of change in post-concussive symptoms and emotional distress. Calls conducted by trained concussion support specialists (CSSs) focus on injury-related education, training in problem solving, and emphasis on behavioral strategies for problems commonly associated with MTBI. The relative effects of ISTS and usual care on post-concussion symptom severity and symptoms of emotional distress will be compared at six month follow-up.

Transportable Telehealth Units

Our increasingly mobile and tech-savvy society will demand health care that is more patient- than provider-centric, such that consumers want health care delivery mechanisms that fit their needs and lifestyles rather than the requirements of office-based care. A prominent aspect of this future direction is the use of technology to provide care in non-traditional locations, such as mobile health clinics, as well as in traditional and previously expected locations, such as a patient's home. Mobile health clinics (MHCs) historically have afforded a convenient and acceptable portal into the health care system for a range of at-risk populations seeking a diverse array of services. Often, MHCs are used to provide in-person care to individuals considered to be medically disenfranchised due to lack of adequate insurance or other access barriers, such as mobility, geography, stigma, or trust. In this context MHCs are viewed as serving the health care system as safety net clinics rather than as an important component of the broader health care spectrum. This view has limited industry conceptions of how MHCs may be used by health care consumers as interconnected specialty clinics of choice. For example, while synchronous telehealth is considered a standard of care and the use of mobile clinics for primary, dental, and other care are common, there are few examples where the two have been combined to deliver ongoing telebehavioral health care. T2 has taken a lead in identifying the role that these flexible and deployable telebehavioral health platforms may play in overcoming access to care barriers to connect service members and their families to an integrated Defense Department telebehavioral health system of care. A primary example is a partnership between T2 and Tripler Army Medical Center (TAMC) to utilize modified and telehealth-equipped shipping containers to deliver PH/TBI telebehavioral health care to Defense Department beneficiaries on American Samoa. The most remote territory of the United States, American Samoa has a population of approximately 68,000 who serve our Nation in great numbers, including a disproportionate number of combat casualties in Iraq and Afghanistan. Following a health care needs assessment in various locations across the Pacific region, American Samoa was identified as having critical gaps in health care services due to its remote location and level of available resources. The late September 2009 tsunami and redeployment of the (predominantly Samoan) 100th Battalion heightened awareness of these gaps in care. It was determined that placement of a Transportable Telehealth Unit (TTU; modified shipping container) on American Samoa would greatly increase access to

PH/TBI care, while reducing travel cost and time through telehealth connections to providers at TAMC. The first clinical encounter occurred in September 2010 and initial anecdotal feedback indicates that this partnership will succeed at providing access to care for an at-need population of remotely located service members and their families.

E-Mail

ADVANTAGES

A primary advantage of email outreach for addressing health needs is that it reaches a large number of people efficiently and affordably, and is consequently cost-effective for large scale community outreach programs. Myriad health studies and clinical and public health programs have successfully employed email components for education and health promotion,[54] compliance,[55] clinical alerts,[56, 57] recruitment,[58] surveying, diagnosis,[59] and interventions.[60]

EXAMPLES

While it is common for email to be used in health research and practice for promotion, surveying, scheduling, and reminders, or as an alert system for compliance or the recruitment of study participants, the employment of email as a health intervention is relatively unusual. One simple email intervention that shows promise is the *T2 Caring Letters* Project. *Caring Letters* is a suicide prevention outreach program that sends brief, personalized email messages containing expressions of care and reminders of available treatment to patients presumed to be at high risk for suicide after leaving an inpatient psychiatry unit. The goal of *Caring Letters* is to reduce suicide attempts and mortality, especially among patients who do not seek follow-up care. Originally developed and evaluated by Motto,[61, 62] the concept of *Caring Letters* is currently the only psychological intervention that has reduced the rate of death by suicide in a randomized clinical trial.[63, 64] In previous trials, caring messages were sent to discharged psychiatric patients in the form of personalized, typed letters[61] or non-personalized caring postcards.[65] However, in T2 feasibility trials of the methodology at Madigan Army Medical Center (MAMC), 63 percent of participants drawn from service members discharged from the MAMC psychiatric inpatient unit indicated that they would prefer caring messages by email. In a definitive test of e-mail as an effective intervention technology in a military population, T2 is embarking on a five-year, multi-site, randomized control trial that will compare the C*aring Letters* intervention to usual care. Participants will be recruited from inpatient psychiatry units of collaborating military and VA sites and randomized to either a group that receives caring emails or a usual care group that does not. This study will fill an important gap in the evidence base for the use of email technology to deliver the *Caring Letters* intervention.

Social Networking and Online Communities

ADVANTAGES

Online social networking sites, such as Facebook and MySpace, are the current boom applications of the Internet among younger adults. Nearly three-fourths of young adults in the U.S. use social networking sites, and even older adults (30 years and older) use social networks in moderate proportions (40 percent in 2009).[66] Social networking sites enable users to create web-based personal profiles, communicate within their personalized social networks via posted texts, email, instant messaging, and links to other sites and resources with an added sense of community. An advantage of social networking sites for health communication, education, promotion, and outreach is that they facilitate social connections and foster supportive connections among peers with similar experiences and levels of mutual trust. Although unregulated or unmonitored social networks have the potential to generate both

positive and negative behaviors, and both adaptive and ill-adaptive mind-sets, those sites with monitors or live watchdogs ideally can steer conversation toward adaptive dialogue and positive behaviors. Monitors can further help ensure that those who indicate crisis states or a need for mental health care be connected to a professional.

EXAMPLES

The Defense Department released its first comprehensive social media policy on February 26, 2010, directing that, across the services, the non-classified network's default setting would allow access to social media pages. The department also launched its own social media hub,[67] linking to Facebook, Twitter, YouTube, Flickr and other social applications. Within T2, *afterdeployment.org* fully incorporates popular social networks, RSS feeds, blogs, and podcasts as significant site components. Dedicated links to Facebook, Twitter, and other social media are embedded within the site and a corresponding *afterdeployment.org* Facebook profile is well established.

Mobile Access and Wireless Platforms

ADVANTAGES

Perhaps the biggest techno-social transformation in recent years has been the proliferation of highly portable, wireless multimedia and communication devices, such as smartphones and notebook or touchpad computers. In 2010, 59 percent of U.S. adult Internet users accessed the Internet wirelessly using a laptop or cell phone. Nearly half of U.S. adults went online using a laptop and a Wi-Fi connection or mobile broadband card, while 40 percent used mobile phones to access the Internet, email, and instant messaging. For cell phone users, significant increases have been recorded in the last year in the use of their mobile devices for taking pictures (76 percent in 2010), texting (72 percent), accessing the Internet (38 percent), emailing (34 percent), video-recording (34 percent), playing music (33 percent), and instant messaging (30 percent). [68] Within five years, 70 percent of collaboration and communications applications designed on PCs will be modeled after user experience lessons from smartphone collaboration applications. [69] In fact, websites not optimized for the smaller-screen formats will become a market barrier for their owners — much content and many sites will need to be reformatted or rebuilt altogether. Perhaps most relevant to leveraging technology for health care, hundreds of thousands of software applications or "apps" for iPhone, Android, Blackberry, and other smartphone systems have been developed and made available for mobile users, including many health-related apps. At least 35 percent of U.S. adults already have apps on their phones.[70] The potential of apps for health care appears to be unlimited. For example, apps can be designed to help users self-assess and monitor psychiatric symptoms. Users can personalize content and access hotline links, psychological tools (e.g., relaxation exercises), and appointment reminders. Recognizing the utility of hand-held systems and the emergence of an "apps culture," the U.S. Defense Advanced Projects Research Agency (DARPA) recently issued a funding opportunity soliciting proposals to create a centralized marketplace for military apps for mobile handheld devices.[71]

Table 1 illustrates the variety of advantages mobile platforms potentially hold over conventional delivery media.

Table 1: Advantages of Mobile Platforms in Behavioral Health Delivery

Evidence-based content can be versioned for an array of devices (cell phones, smart phones, handheld media players, netbooks, eBooks, etc.)
Smartphones, while generally more expensive than their basic cell phone counterparts, offer platforms that can support various materials, including assessment surveys, hotlines, videos, and resource locators.
Handheld devices can connect wirelessly, such as from a cell phone or with Wi-Fi, improving data-transmission options
Two-way connectivity increases contact options with support systems (e.g., telephone, instant messaging, email, video chat).
The availability of multiple systems increases users' information-retrieval options and allows users to select their preferred delivery system
In many cases, data can be transferred from one device or platform to another, underscoring the portability of information and allowing data to 'travel' with the user.
Data can be transmitted bilaterally between user and provider.
Handheld devices are physically 'hip-pocket' accessible.
Portable access enhances continuity of clinical services across regions and time zones, and allows for useful reminders and "teachable moments" (e.g., scheduled appointments, health tips, etc.)
Mobile platforms allow users to manage mild symptoms, and to track and assess adjustment difficulties in real time rather than retrospectively.
Stand-alone apps can be obtained anonymously (e.g., via iTunes), supporting stigma-free access.
Users can self-pace their use of content obtained via a mobile platform, instead of more traditional appointment-driven access to consultation.
Apps' content can be systematically updated to reflect current research and the latest technologies.
Mobile devices can augment providers' clinical practices (e.g., between-session assignments).
Some portable or handheld devices (e.g., netbooks, more recent iPhones) are equipped with webcams that would enable users to link to a provider from a distance.

EXAMPLES

Mobile technology has a particular synergy within the military culture. According to the Dec. 11, 2009 issue of *Federal Computer Week*, a government policy and management authority magazine and website, "Army officials are tapping into the ingenuity of its young workforce and responding to their predisposition for smarter gadgets at the same time by developing an array of Go Mobile devices that can fit into a soldier's pocket…"[72] More than two-dozen, mobile applications or "apps" are being developed at T2, including apps for targeting mood-monitoring (T2 Mood Tracker), stress management (Breathe2Relax), and quick 'reads' of adjustment following critical incidents in deployment settings (T2 Mobile Screener).

T2 MoodTracker

Self-monitoring of behavior and affective states has been demonstrated to incite behavioral change both directly and as adjunct to therapeutic interventions.[73, 74] Historically, there have been a number of barriers to effective and efficient self-monitoring. Barriers are generally associated with the response cost associated with data collection, such as patients forgetting to record data or maintain recording materials, awkward recording strategies, and difficulty translating records into meaningful and useful data. Smart phone technology provides an easily accessible platform for developing self-monitoring software using a visual analogue scale (VAS). A VAS conventionally is a horizontal line on a paper survey anchored by word descriptors or labels at each end. A user marks on the line the point that they feel represents their perception of their current state. Released to the Android marketplace in September 2010, T2 MoodTracker is a comprehensive self-monitoring tool built on an Android Smart Phone platform. MoodTracker presents electronic VASs that allow users to quickly and conveniently indicate their moods

on various scales using the smartphone touch screen, and then to view their various mood scores on color graphs over time.

Breathe2Relax

The iBreathe application is a portable diaphragmatic breathing skill-rehearsal tool that can be used as a stand-alone stress reduction tool or a supplementary resource to face-to-face care. With audio/video-based instruction that explains the body's reaction to stressors and belly breathing techniques to reduce stress, the application offers illustrative examples, guided exercises, practice sessions, pre-/post-stress ratings and charts, and a journal, allowing users to track their progress with customizable features and personal notes. The diaphragmatic breathing (belly-breathing) technique has widely-known benefits in the reduction of stress, tension, and anxiety, and in calming the "fight or flight" response to better focus the mind and the body. With the mobility and convenience of "hip pocket" accessibility, this guided exercise becomes accessible when most needed to calm the "fight or flight" response, improve focus and attention, and re-energize the body. The public release of Breathe2Relax to iTunes is scheduled for May 2011.

T2 Mobile Screener

The T2 Mobile Screener is an abbreviated battery of automated assessments. It provides quantitative data obtained from standardized tools tapping affective symptoms (anger, depression, anxiety), physical symptoms, self-report of feelings of behavioral self-control, level of exposure to potentially stressful life events, and perception of social support. The application is intended to support critical analysis of the need for a higher echelon of care in deployed or field environments and to support commands during combat-related critical incidents. Use of the T2 Mobile Screener would occur in tandem with a provider or healthcare specialist; that is, data would upload immediately for review by a qualified professional. Portable screening tools have the potential for widespread application; however, the T2 Mobile Screener is being developed exclusively for military use.

Short Message Service (SMS) - Texting

Basic cell phones can function as a texting delivery system for various wellness materials: health tips, topical quotes, announcements, crisis numbers, quizzes, and scheduling and appointment reminders. Cell phones are easy to use and do not require Internet access. The Army's mCare research program[7] is using mobile technology to determine if wounded warriors have a better recovery if they are in frequent contact with their case managers. mCare sends daily text messages to Army Reservists and National Guard members recuperating in their home locations directly to their mobile phones. Among other things, health tips, appointment reminders, and general announcements are distributed from a secure, central website where health care providers can enter and control the message content, as well as review acknowledgements and delivery confirmations.

Virtual Reality/Virtual Worlds

ADVANTAGES

In contrast to holistic treatments in integrative medicine, technology can also offer an alternative tool to deliver a standard treatment or common psychoeducation. To this end, virtual reality (VR) and virtual worlds (VW) may provide additional capabilities beyond some of the technologies reviewed above.

Virtual reality can be defined as a human-computer interface that uses a range of computers and peripherals to deliver information in multiple forms, often through multiple senses.[8] A virtual environment is typically navigated and explored by a patient using a head-mounted audio-video display (HMD), and

motion tracking devices attached to the HMD, and sometimes hands or feet. More sophisticated VR systems may further incorporate the senses of touch and smell through haptic and olfactory feedback devices. The intent of VR is to provide a user with a sense of presence or the vivid perception of physical immersion in a virtual environment.

Virtual reality holds particular promise in the treatment of anxiety disorders and in the treatment of PTSD. For example, VR may have considerable advantages over more conventional psychotherapeutic modes when delivering such interventions as exposure therapy that already utilize imaginal and/or in vivo techniques. Exposure therapy is one of the best-supported treatments for PTSD[75] and has demonstrated effectiveness with a range of trauma populations, including female veterans,[76] sexual assault survivors,[77] physical assault survivors, motor vehicle accident survivors,[78] and survivors of natural disasters.[79] Exposure therapy is a cognitive behavioral treatment that involves confronting the memory of the traumatic event, typically by closing one's eyes and recalling the event in one's mind. This form of exposure is called imaginal exposure and is used widely in exposure-based protocols for PTSD.[80] A second component of most protocols for exposure therapy is in vivo exposure. In vivo exposure involves the confrontation of activities, places, and situations in one's daily life that are avoided, because they remind the person of the trauma and elicit anxiety. With repeated, prolonged exposure to the memory and anxiety-provoking circumstances, habituation takes place and anxiety is reduced. As effective as conventional exposure therapy has been in previous studies of PTSD,[81] patients with combat trauma have benefited less from treatments relative to patients with other trauma types.[82] Given the role of high emotional engagement in a positive treatment outcome,[83] it is possible that veterans of combat develop adaptive emotional disengagement during deployment, which later interferes with activation of the memory during exposure. Multisensory VR may leverage auditory, visual, tactile, and olfactory stimuli to activate the memory in non-verbal ways, which may increase emotional engagement during exposure and could result in a better clinical outcome. Because VR takes place in a controlled environment while generating a sense of the in vivo experience, patients may feel safer and more self-efficacious.

Our definition of VR includes the assumption that VR systems are stand-alone systems. In contrast, we define virtual worlds (VWs) as shared 3D environments where multiple users can connect to a computer-generated environment via the Internet and represent themselves and interact via avatars. Avatars, or virtual representations of oneself, can typically be customized in a wide variety of ways, giving the user creative options for self-representation. Virtual worlds also may be a promising tool to support the PH and TBI needs of warriors, veterans, and their families. Besides allowing anonymous access 24-hours a day, the information delivered in VWs is an interactive format that can even leverage gaming types of motivation. Because multiple users can interact in the same space, there is also the potential to connect remotely located individuals. Psychoeducational resources are typically delivered via text-based paper media or websites. It is possible that 3D game-like VWs will provide a more appealing method for delivering content and increase use and dissemination of key content. There is, of course, the risk that some service members might become too immersed in networking online at the expense of a fuller connection with family and friends in the more immediate environment. However, given the common emotional detachment and interpersonal isolation that occurs with service members with PTSD and other PH problems, the ability to connect with other users in a shared VW space may nonetheless be beneficial in providing social support. Moreover, this shared space may provide a forum for efficient provider training on clinical practice guidelines or evidence-based treatments.

EXAMPLES

In the civilian world, VR exposure has demonstrated positive preliminary results in several studies of PTSD. A case series of six survivors of motor vehicles accidents used a VR driving simulator to deliver exposure therapy.[84] Statistically significant and clinically meaningful reductions in PTSD symptoms were reported. Another study utilized a VR World Trade Center environment to treat 10 survivors of the events of September 11, 2001.[85] Relative to their pre-treatment baseline and relative to a waitlist control group,

this quasi-experimental study found significant reductions in PTSD symptoms. Five of the 10 VR patients had previously received a traditional form of exposure therapy and demonstrated limited benefit. Similarly, a case report of a patient who survived a terrorist attack in Israel was treated with a virtual bus bombing exposure protocol.[86] After 10 treatment sessions, the patient reported large magnitude reductions in symptoms of PTSD.

In the military arena, preliminary results are promising for the effectiveness of VR exposure for combat-related trauma. Several studies found positive results treating Vietnam veterans with VR-based exposure protocols. For example, a case study of a Vietnam veteran reported reductions on all measures of PTSD and depression following treatment with a VR exposure protocol.[87] An open clinical trial used a virtual Vietnam to deliver approximately 13 exposure therapy sessions to 10 veterans. Treatment resulted in reductions in PTSD symptoms and depression that reached a statistically significant change at the three-month and six-month follow-ups.

Early results are also encouraging for using VR exposure with survivors of trauma resulting from OIF/OEF. An active-duty soldier with combat-related trauma that occurred during a deployment to Iraq was treated with VR exposure.[88] After six VR Iraq treatment sessions, the patient reported a significant reduction in self-reported symptoms of PTSD relative to his pre-treatment baseline. Another case study reported the treatment outcomes of using VR exposure to treat a National Guardsman with PTSD following deployment to Iraq.[89] Using the same VR Iraq environment as the previously cited study, the patient reported a clinically meaningful reduction in symptoms of PTSD. Finally, T2 conducted the largest study of VR exposure for PTSD to date and reported on the effectiveness of VR exposure to treat 24 active duty soldiers with combat-related PTSD symptoms.[10] Relative to pre-treatment self-reported symptoms of PTSD, soldiers reported a statistically significant reduction in symptoms. Sixty-two percent of patients reported a reliable change in symptoms as a result of VR exposure.

Next Steps

"Efforts to address the problem of stigma and other barriers to seeking mental health care in the military should take into consideration outreach, education, and *changes in the models of health care delivery…"*[11]

As patient and provider comfort increases with new technological models of health care delivery, and as line leaders, trained peer counselors, family units, and individual service members realize increased access, behavioral health researchers and providers will have the opportunity to leverage these technologies even further. With video by phone now a reality, the ability to video-teleconference (VTC) sessions with patients at their home is becoming an opportunity. Just as the community doctor used to visit his patients at their homes, he or she will now again be able to VTC to the patient's home creating the virtual home visit. The affordances of this will make it not just an acceptable alternative, but a mode that offers additional valuable information. For example, a clinician may be able to remotely monitor how the patient lives in his home, what privacy he may have, and what level of cleanliness and organization he is able to execute. Observing interactions with others in a naturalistic environment all become possible (and reasonable).

As we integrate physiological sensors into our interactions, we can offer patients immediate feedback regarding their physiologic state in association with various settings and situations. We can track and record these throughout the day, offering a plethora of new information for the provider. When integrated with real-time, subjective and objective responses by the individual, the pattern of interplay between the individuals experience will be able to be explored in new ways. In some situations, such as parenting interactions, patients can run video in real time in the home with TIVO-like capture of the key linked video

sessions, allowing clinicians to replay and review the video.

Challenges persist. Because technologies continue to evolve so rapidly, we will need new models for research and evaluation. For example, a multi-year randomized controlled trial using key components of the original iPhone will miss the opportunities that the iPhone 4 or Android offer today. The ability to apply general research principles safely to the new technologies will be essential to effectively leverage the opportunities that technology affords.

Within the general population, under the best of circumstances, sustained motivation to obtain help with problems can vary and be reflected in what traditionally has been understood as treatment "resistance" or non-compliance. Efforts to engage the military population must additionally consider that receiving help is not necessarily consistent with the warrior ethos. Service members' concerns about engaging psychological services range from being viewed as weak, to worries about job security, promotions, and security clearances. Further, psychological concepts and behavior-change strategies, presented textually, can be complex and difficult to understand. It behooves subject experts working in technology fields to develop behavioral materials and applications that consider the military population's variability in education, motivation to change, and need for confidentiality. Behavioral materials aimed at this population should engage, educate, and entertain.

Going forward, users will interface with psychological concepts through various media and 'transmedia.' Digital games, graphic novels, and audio and video podcasts, comprise platforms by which content can be tailored to appeal to various audiences. These platforms allow materials to be subdivided or partitioned to support divided attention spans dealing with multiple tasks. A virtual, handheld clinic equipped with multiple tools would support in vivo management of mild symptoms. Picture someone who is anxious about his dentist appointment; prior to the office visit, he reaches for his hip-pocket iPhone or Droid, taps a key, and hears a melodious and soothing voice walk him through a deep-breathing exercise. In contrast with stand-alone resources, such as a tactical breathing exercise to assist with in-the-moment stressors, mobile platforms can be used in tandem with professional consultation, wherein a provider would instruct a user to maintain a behavioral activation record on a mobile app and transmit that information on a daily or weekly basis for review and feedback. In fact, the twenty-first century provider will bring to his or her clinical practice a plethora of innovative tools aimed at changing behavior and capturing and holding the attention of the end-user.

Web-based tools would be configured to offer a "stepped-care" approach in which users log on, take an assessment, view an educational video, read some topical text, and learn a skill, such as time management or sleep hygiene. The user would pace their efforts and access resources privately and on their own schedule. In the event that self-care was not helping, the user could elevate their care telephonically via the site's hotlines, or by chatting via instant-messaging. Next generation websites would provide a virtual call center that link users to triage and, subsequently, telehealth with a credentialed provider. Interested users could link to developers to assist with product concepts (user-centered collaboration), and outcomes research recruitment could be engaged via the Web.

The Web can serve as a flashpoint for peer-to-peer resource sharing and social networking, and for providers to interface concerning difficult cases and training opportunities. Sites can be 'skinned' to accommodate user preferences, and dashboards would allow users to establish a repository of favorites.

Surely, technology moves rapidly; near-term development will improve the user interface. The ability to observe, learn, practice, and obtain feedback through a personal avatar allows methods that are not otherwise possible. One can be put into challenging virtual situations that offer mastery outcome and allow safe rehearsal of behavior. The feedback provided can be controlled and titrated, the complexity of the interaction monitored, and the outcome controlled. Once mastered in this method the transition to in vivo interactions can be integrated. Highly impractical scenarios in real world settings can be easily and efficiently developed. Experiences can be augmented with the sights, sounds, smells, and senses of the

experience. Avatars already are being used to assist travelers.[90, 91] While rudimentary, these virtual assistants respond to keyboard-entered queries, such as travel planning and restaurant searches. Web-based virtual agent technology would engage, support, and optimize the user's experience. A humanizing, natural language interface would assist users to more effectively *search and navigate* complex materials. A "virtual agent" would *orient* the user to site content, links, and call center functions. Users unsure of their needs could query the virtual agent for guidance. Users would obtain assistance with basic *treatment/ curriculum planning;* if a user queried the virtual agent regarding the site's stress materials, the virtual agent would describe a 'best approach' to the materials (e.g., begin with an assessment, then view an educational video, and then participate in an online, self-paced workshop). The virtual agent would *remember* the user across visits (i.e., the user's site usage history). During follow-up site visits, the virtual agent's assistance would become increasingly personalized and tailored to the user's preferences; over time, *rapport* would evolve between the user and the virtual agent. During return visits, the virtual agent would welcome the user, "remind" the user of activities engaged in during the last visit(s), and encourage the user to query for more information. The virtual agent would serve as a user's data repository or personalized dashboard, allowing the user to readily track prior site activity.

Conclusion

Despite the extraordinary benefits of using these technologies to deliver and access health care, there may be resistance or barriers to adopting such tools. A lack of familiarity, comfort, and awareness of the full capabilities of these technologies may inhibit some from using them. Conducting clinical assessments or treatment via videoconference or webcam requires a new set of skills that some care providers may not have. While new users may see the ease and advantage of using telebehavioral health care over time, in the short-term they may be disinclined or struggle to learn how to operate the new medium.[92] Moreover, health care providers and patients alike may have concerns about the privacy, security, and protection of personal information, causing some to eschew social media. To overcome these barriers, users will need to perceive the benefit, convenience, and integration of the technology into their daily lives.[93] It is likely that user demand and engagement will drive the usage of social media and new technology; health care providers, even those most skeptical and unfamiliar of technology, will need to consider adapting to provide care through the means most accessible, affordable, and effective to their patients.

Clearly technology is an important component of the changing models of health care delivery. For those who may need or at least benefit from behavioral health care, technology also offers new opportunities to pull users in. Technology can take advantage of familiar interfaces, provide safe and secure interactions that the patient can control, offer services when and where the user wants to receive them, and in many cases deliver treatment that may be more engaging to the user. Multiple technologies offer potential new ways to address the problems facing the military today. By crossing the geographic and psychological barriers through the use of online, distributed, or mobile models, treatments now can be delivered that heretofore were the sole domain of the office visit.

Bibliography

CITED SOURCES

1. American Psychological Association Presidential Task Force on Military Deployment Services for Youth, Families and Service Members: The Psychological Needs of U.S. Military Service Members and Their Families: A Preliminary Report. 2007. http://www.apa.org/about/governance/council/policy/military-deployment-services.pdf.
2. Murray CK, Reynolds JC, Schroeder JM, Harrison MB, Evans OM, Hospenthal DR. Spectrum of care provided at an echelon II Medical Unit during Operation Iraqi Freedom. *Mil Med.* Jun 2005;170(6):516-520.
3. Warden D. Military TBI during the Iraq and Afghanistan wars. *J Head Trauma Rehabil.* Sep-Oct 2006;21(5):398-402.
4. *Department of Defense Suicide Event Report (DoDSER): Calendar Year 2008 Annual Report*: National Center for Telehealth & Technology, Defense Centers of Excellence for Psychological Health & TBI;2008.
5. eTForecasts. Internet User Forecast by Country. 2010. http://www.etforecasts.com/products/ES_intusersv2.htm#1.0. Accessed September 28, 2010.
6. The National Center for Telehealth and Technology. 2010; http://t2health.org/. Accessed December 17, 2010.
7. TATRC. mCare: Mobile Care. 2010; http://www.tatrc.org/?p=locs/south/events. Accessed October 29, 2010.
8. Stanney KM, Zyda M. Virtual environments in the 21st century. . In: Stanney KM, ed. *Handbook of Virtual Environments: Design Implementation, and Applications*. Mahwah, NJ: Lawrence Erlbaum; 2002.
9. Rothbaum BO, Hodges LF, Ready D, Graap K, Alarcon RD. Virtual reality exposure therapy for Vietnam veterans with posttraumatic stress disorder. *J Clin Psychiatry.* Aug 2001;62(8):617-622.
10. Reger GM, Holloway KM, Candy C, et al. Effectiveness of virtual reality exposure therapy for active duty soldiers in a military mental health clinic. . *Journal of Traumatic Stress.* In Press.
11. Hoge CW, Castro CA, Messer SC, McGurk D, Cotting DI, Koffman RL. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med.* Jul 1 2004;351(1):13-22.
12. Hoge CW, Auchterlonie JL, Milliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *Jama.* Mar 1 2006;295(9):1023-1032.
13. Milliken CS, Auchterlonie JL, Hoge CW. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *Jama.* Nov 14 2007;298(18):2141-2148.
14. Thomas JL, Wilk JE, Riviere LA, McGurk D, Castro CA, Hoge CW. Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Arch Gen Psychiatry.* Jun 2010;67(6):614-623.
15. Seal KH, Bertenthal D, Miner CR, Sen S, Marmar C. Bringing the war back home: mental health disorders among 103,788 U.S. veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. *Arch Intern Med.* Mar 12 2007;167(5):476-482.
16. Dohrenwend BP, Turner JB, Turse NA, Adams BG, Koenen KC, Marshall R. The psychological risks of Vietnam for U.S. veterans: a revisit with new data and methods. *Science.* Aug 18 2006;313(5789):979-982.
17. Terrio H, Brenner LA, Ivins BJ, et al. Traumatic brain injury screening: preliminary findings in a U.S. Army Brigade Combat Team. *J Head Trauma Rehabil.* Jan-Feb 2009;24(1):14-23.
18. Bombardier CH, Fann JR, Temkin N, et al. Posttraumatic stress disorder symptoms during the first six months after traumatic brain injury. *J Neuropsychiatry Clin Neurosci.* Fall 2006;18(4):501-508.
19. Warden DL, Labbate LA, Salazar AM, et al. Posttraumatic stress disorder in patients with traumatic brain injury and amnesia for the event? *J Neuropsychiatry Clin Neurosci.* Winter 1997;9(1):18-22.
20. Tanelian T, Jaycox LH. *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery.* Arlington, VA: Rand Corporation Center for Military Health Policy Research;2008.
21. Bombardier CH, Fann JR, Temkin NR, Esselman PC, Barber J, Dikmen SS. Rates of major depressive disorder and clinical outcomes following traumatic brain injury. *JAMA.* May 19 2010;303(19):1938-1945.
22. Kang HK, Bullman TA. Is there an epidemic of suicides among current and former U.S. military personnel? *Ann Epidemiol.* Oct 2009;19(10):757-760.
23. National Violent Death Reporting System: Centers for Disease Control and Prevention. 2009; http://www.cdc.gov/ViolencePrevention/NVDRS/index.html, 2010.
24. Katon WJ. Clinical and health services relationships between major depression, depressive symptoms, and general medical illness. *Biol Psychiatry.* Aug 1 2003;54(3):216-226.
25. Adler NE, Page AEK. *Cancer Care for the Whole Patient: Meeting Psychosocial Health Needs.* Washington, DC: Institute of Medicine of the National Academies;2008.

26.   Aaronson NK. Quality of life: what is it? How should it be measured? *Oncology (Huntingt).* May 1988;2(5):69-76, 64.

27.   Bush N, Donaldson G, Moinpour C, et al. Development, feasibility and compliance of a web-based system for very frequent QOL and symptom home self-assessment after hematopoietic stem cell transplantation. *Qual Life Res.* Feb 2005;14(1):77-93.

28.   Smith TC, Ryan MA, Smith B, et al. Complementary and alternative medicine use among U.S. Navy and Marine Corps personnel. *BMC Complement Altern Med.* 2007;7:16.

29.   Defense Manpower Data Center. 2010; https://www.dmdc.osd.mil/appj/dwp/index.jsp. Accessed 27 September, 2010.

30.   Pew Internet and American Life Project. 2010; http://www.pewinternet.org/. Accessed September 28, 2010.

31.   Home Broadband 2010. 2010; http://www.pewinternet.org/Reports/2010/Home-Broadband-2010.aspx. Accessed September 28, 2010.

32.   Ferguson T. Health online and the empowered medical consumer. *Jt Comm J Qual Improv.* May 1997;23(5):251-257.

33.   Scott WG, Scott HM, Auld TS. Consumer access to health information on the internet: health policy implications. *Aust New Zealand Health Policy.* Jun 28 2005;2:13.

34.   Mishoe SC. Consumer health care information on the internet: does the public benefit? *Respir Care.* Oct 2008;53(10):1285-1286.

35.   Pietrzak RH, Goldstein MB, Malley JC, Rivers AJ, Johnson DC, Southwick SM. Risk and protective factors associated with suicidal ideation in veterans of Operations Enduring Freedom and Iraqi Freedom. *J Affect Disord.* Jun 2010;123(1-3):102-107.

36.   Kim PY, Thomas JL, Wilk JE, Castro CA, Hoge CW. Stigma, barriers to care, and use of mental health services among active duty and National Guard soldiers after combat. *Psychiatr Serv.* Jun 2010;61(6):582-588.

37.   Greene-Shortridge TM, Britt TW, Castro CA. The stigma of mental health problems in the military. *Mil Med.* Feb 2007;172(2):157-161.

38.   Bush NE, Bowen D, J., Wooldridge JA, Ludwig A, Meischke H, Robbins R. What do we mean by Internet Access? A Framework for Health Researchers. 2004; www.cdc.gov/pcd/issues/2004/oct/04_0019.htm. Accessed September 15, 2004.

39.   Comprehensive Soldier Fitness: Strong Minds, Strong Bodies. 2010; http://www.army.mil/csf/. Accessed October 11, 2010.

40.   Naval Center Combat and Operational Stress Control (COSC). 2010; http://www.med.navy.mil/sites/nmcsd/nccosc/. Accessed December 29, 2010.

41.   Air Combat Command Comprehensive Airman Fitness Program. 2010; http://www.acc.af.mil/library/acccomprehensiveairmanfitness/index.asp. Accessed December 28, 2010.

42.   Purcell K. The State of Online Video 2010; http://www.pewinternet.org/Reports/2010/State-of-Online-Video.aspx. Accessed September 28, 2010.

43.   Andersson G, Bergstrom J, Hollandare F, Carlbring P, Kaldo V, Ekselius L. Internet-based self-help for depression: randomised controlled trial. *Br J Psychiatry.* Nov 2005;187:456-461.

44.   Christensen H, Griffiths KM, Jorm AF. Delivering interventions for depression by using the internet: randomised controlled trial. *Bmj.* Jan 31 2004;328(7434):265.

45.   Frueh BC, Monnier J, Yim E, Grubaugh AL, Hamner MB, Knapp RG. A randomized trial of telepsychiatry for post-traumatic stress disorder. *J Telemed Telecare.* 2007;13(3):142-147.

46.   Germain V, Marchand A, Bouchard S, Drouin MS, Guay S. Effectiveness of cognitive behavioural therapy administered by videoconference for posttraumatic stress disorder. *Cogn Behav Ther.* 2009;38(1):42-53.

47.   Morland LA, Pierce K, Wong MY. Telemedicine and coping skills groups for Pacific Island veterans with post-traumatic stress disorder: a pilot study. *J Telemed Telecare.* 2004;10(5):286-289.

48.   Tricare. 2010; http://www.tricare.mil/ Accessed October 13, 2010.

49.   Luxton DD, Sirotin AP, Mishkind MC. Safety of telemental healthcare delivered to clinically unsupervised settings: a systematic review. *Telemed J E Health.* Jul-Aug 2010;16(6):705-711.

50.   Lenhart A. Cell phones and American adults 2010; http://www.pewinternet.org/Reports/2010/Cell-Phones-and-American-Adults.aspx. Accessed September 28, 2010.

51.   Simon GE, Ludman EJ, Tutty S, Operskalski B, Von Korff M. Telephone psychotherapy and telephone care management for primary care patients starting antidepressant treatment: a randomized controlled trial. *JAMA.* Aug 25 2004;292(8):935-942.

52.   Bell KR, Hoffman JM, Temkin NR, et al. The effect of telephone counselling on reducing post-traumatic symptoms after mild traumatic brain injury: a randomised trial. *J Neurol Neurosurg Psychiatry.* Nov 2008;79(11):1275-1281.

53.   Effect of Telephone Follow-up on Outcome for Warriors with Mild TBI/PTSD: The Injury and Traumatic Stress (INTRUST) Consortium 2010; http://intrust.sdsc.edu/. Accessed October 1, 2010.

54.   Atherton H, Huckvale C, Car J. Communicating health promotion and disease prevention information to patients via email: a review. *J Telemed Telecare.* 2010;16(4):172-175.

55. Ludlow H, Hurley J, Dolwani S. Using email and text messaging to improve patient compliance with blood monitoring. *Nurs Times.* Jul 21-27 2009;105(28):26-28.

56. Pluye P, Grad RM, Granikov V, Jagosh J, Leung K. Evaluation of email alerts in practice: part 1 - review of the literature on clinical emailing channels. *J Eval Clin Pract.* Aug 15 2010.

57. Houston TK, Coley HL, Sadasivam RS, et al. Impact of Content-Specific Email Reminders on Provider Participation in an Online Intervention: A Denta PBRN Study. *Stud Health Technol Inform.* 2010;160:801-805.

58. Norton TR, Lazev AB, Schnoll RA, Miller SM. The impact of email recruitment on our understanding of college smoking. *Addict Behav.* Jun-Jul 2009;34(6-7):531-535.

59. Torres-Pereira C, Possebon RS, Simoes A, et al. Email for distance diagnosis of oral diseases: a preliminary study of teledentistry. *J Telemed Telecare.* 2008;14(8):435-438.

60. Robinson P, Serfaty M. Getting better byte by byte: a pilot randomised controlled trial of email therapy for bulimia nervosa and binge eating disorder. *Eur Eat Disord Rev.* Mar 2008;16(2):84-93.

61. Motto JA. Suicide prevention for high-risk persons who refuse treatment. *Suicide Life Threat Behav.* Winter 1976;6(4):223-230.

62. Motto JA, Bostrom AG. A randomized controlled trial of postcrisis suicide prevention.[see comment]. *Psychiatric Services.* Jun 2001;52(6):828-833.

63. Comtois KA, Linehan MM. Psychosocial treatments of suicidal behaviors: a practice-friendly review. *J Clin Psychol.* Feb 2006;62(2):161-170.

64. Joiner TE, & Van Orden, K.A. The interpersonal-psychological theory of suicidal behavior indicates specific and crucial psychotherapeutic targets. *International Journal of Cognitive Psychology.* 2008;1(1):80-89.

65. Carter GL, Clover K, Whyte IM, Dawson AH, D'Este C. Postcards from the EDge project: randomised controlled trial of an intervention using postcards to reduce repetition of hospital treated deliberate self poisoning. *BMJ.* Oct 8 2005;331(7520):805.

66. Lenhart A, Purcell K, Smith A, Zickuhr K. Social Media and Young Adults 2010; http://www.pewinternet.org/Reports/2010/Social-Media-and-Young-Adults.aspx. Accessed September 28, 2010.

67. DOD Social Media Hub. 2010; http://socialmedia.defense.gov/. Accessed November 9, 2010.

68. Smith A. Mobile Access 2010. 2010; http://www.pewinternet.org/Reports/2010/Mobile-Access-2010.aspx. Accessed September 28, 2010.

69. Gartner Highlights Key Predictions for IT Organizations and Users in 2010 and Beyond. *Gartner Newsroom.* 2010;2010(October 11). http://www.gartner.com/it/page.jsp?id=1278413.

70. Purcell K, Entner R, Henderson H. The Rise of Apps Culture. 2010; http://www.pewinternet.org/Reports/2010/The-Rise-of-Apps-Culture.aspx. Accessed September 28, 2010.

71. DARPA. Broad Agency Announcement (BAA) DARPA-BAA-10-41: Transformative Apps 2010; http://www.darpa.mil/tcto/docs/DARPA_TA_BAA-10-41_Mod1.pdf. Accessed September 29, 2010.

72. Walsh T. Army's Go Mobile puts big computing power into soldiers' pockets *Federal Computer Week.* 2010;2010(October 11). http://fcw.com/articles/2009/12/11/army-go-mobile-kit-fits-portal-in-a-pocket.aspx.

73. Lightfoot M, Rotheram-Borus MJ, Comulada S, Gundersen G, Reddy V. Self-monitoring of behaviour as a risk reduction strategy for persons living with HIV. *AIDS Care.* Jul 2007;19(6):757-763.

74. Baker R, Kirschenbaum D. Self-monitoring may be necessary for successful weight control. . *Behavior Therapy.* 1993;24:377-394.

75. Cahill SP, Rothbaum BO, Resick PA, Follette VM. Cognitive-behavioral therapy for adults. In: Foa EB, Keane TM, Friedman MJ, Cohen JA, eds. *Effective Treatments for PTSD: Practice Guidelines from the International Society for Traumatic Stress Studies.* Second ed. New York: Guildford; 2009.

76. Schnurr PP, Friedman MJ, Engel CC, et al. Cognitive behavioral therapy for posttraumatic stress disorder in women: a randomized controlled trial. *JAMA.* Feb 28 2007;297(8):820-830.

77. Resick PA, Nishith P, Weaver TL, Astin MC, Feuer CA. A comparison of cognitive-processing therapy with prolonged exposure and a waiting condition for the treatment of chronic posttraumatic stress disorder in female rape victims. *J Consult Clin Psychol.* Aug 2002;70(4):867-879.

78. Bryant RA, Moulds ML, Guthrie RM, Dang ST, Nixon RD. Imaginal exposure alone and imaginal exposure with cognitive restructuring in treatment of posttraumatic stress disorder. *J Consult Clin Psychol.* Aug 2003;71(4):706-712.

79. Basoglu M, Salcioglu E, Livanou M, Kalender D, Acar G. Single-session behavioral treatment of earthquake-related posttraumatic stress disorder: a randomized waiting list controlled trial. *J Trauma Stress.* Feb 2005;18(1):1-11.

80. Foa EB, Hembree EA, Rothbaum BO. *Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences, Therapist guide.* New York, NY: Oxford University Press; 2007.

81. Foa E, Davidson RT, Frances A. The expert consensus guideline series. Treatment of Posttraumatic Stress Disorder. The Expert Consensus Panels for PTSD. *J Clin Psychiatry.* 1999;60 Suppl 16:3-76.

82. Bradley R, Greene J, Russ E, Dutra L, Westen D. A multidimensional meta-analysis of psychotherapy for PTSD. *Am J Psychiatry.* Feb 2005;162(2):214-227.

83.   Jaycox LH, Foa EB, Morral AR. Influence of emotional engagement and habituation on exposure therapy for PTSD. *J Consult Clin Psychol.* Feb 1998;66(1):185-192.
84.   Beck JG, Palyo SA, Winer EH, Schwagler BE, Ang EJ. Virtual Reality Exposure Therapy for PTSD symptoms after a road accident: an uncontrolled case series. *Behav Ther.* Mar 2007;38(1):39-48.
85.   Difede J, Cukor J, Jayasinghe N, et al. Virtual reality exposure therapy for the treatment of posttraumatic stress disorder following September 11, 2001. *J Clin Psychiatry.* Nov 2007;68(11):1639-1647.
86.   Freedman SA, Hoffman HG, Garcia-Palacios A, Tamar Weiss PL, Avitzour S, Josman N. Prolonged exposure and virtual reality-enhanced imaginal exposure for PTSD following a terrorist bulldozer attack: a case study. *Cyberpsychol Behav Soc Netw.* Feb 2010;13(1):95-101.
87.   Rothbaum BO, Hodges L, Alarcon R, et al. Virtual reality exposure therapy for PTSD Vietnam Veterans: a case study. *J Trauma Stress.* Apr 1999;12(2):263-271.
88.   Reger GM, Gahm GA. Virtual reality exposure therapy for active duty soldiers. *J Clin Psychol.* Aug 2008;64(8):940-946.
89.   Gerardi M, Rothbaum BO, Ressler K, Heekin M, Rizzo A. Virtual reality exposure therapy using a virtual Iraq: case report. *J Trauma Stress.* Apr 2008;21(2):209-213.
90.   Meet Jenn, Your Virtual Assistant at alaskaair.com. 2010; http://www.alaskaair.com/as/www2/Help/Site/askJenn.asp. Accessed October 14, 2010.
91.   Continental Airlines: We'd like to introduce you to Alex. 2010; http://www.continental.com/web/en-US/content/contact/alex.aspx. Accessed October 14, 2010.
92.   Folen RA, Jones SL, Stetz MC, Edmonds B, and Carlson J. The Role of Telehealth in Treating Military Personnel. In press. 2010.
93.   Jimison H, Gorman P, Woods S, Nygren P, Walker M, Norris S, & Hersh W. (2008). Barriers and Drivers of Health Information Technology User for the Elderly, Chronically Ill, and Underserved. *Evidence Reports/Technology Assessments No. 175.* Agency for Healthcare Research and Quality.