AN ENTERPRISE ARCHITECTING AND SUSTAINABILITY PILLARS INVESTIGATION OF A CUTTING-EDGE HEALTH CARE AND RESEARCH FACILITY FOR REPLICATION TO ITS SATELLITE CENTERS

by

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ABSTRACT

A 2007 congressional mandate to the U.S. Department of Defense (DOD) concerned instituting a center to address the ever increasing invisible wounds of the Iraq and Afghanistan wars and impact to the Military Health System (MHS) by way of its excellence. The National Intrepid Center of Excellence (NICoE), constructed through private donations secured by the Intrepid Fallen Heroes Fund (IFHF), was established for targeting the comorbid traumatic brain injury (TBI) and psychological health (PH) conditions of these wars. There are three prongs of the NICoE's mission: the first involves the clinical care of services members through diagnosis and treatment, the second education, and the third research, which informs the other two prongs. Interdisciplinary and patient– and family–centric, the clinical care offered is cutting-edge, as well as the research conducted, which is on the forefront of efforts to understand comorbid TBI and PH conditions. The clinical care prong is in the process of being replicated to the NICoE's satellite centers at home bases across the U.S., which have already or will be established. This thesis involves characterizing the NICoE from Enterprise Architecting and Sustainability Pillars frameworks, as well as their interrelationships, to gain holistic understanding of the NICoE as an enterprise in service to the MHS and society in general, which is not evidenced in the literature. This understanding, along with information pertaining to the satellite centers and additional research, is used to recommend guidance in the form of heuristics to the NICoE for its replication to the centers.

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I am also thankful to Debbie Nightingale for the privilege of working on the Post Traumatic Stress Innovation (PTSI) project as a research assistantship. This has exposed me to the critical needs of our service members in terms of clinical care and the cutting-edge work that is being accomplished in service to this goal, which has had a major impact on me that I will carry forward.

I am very grateful for Pat Hale and his wonderful staff for honoring me with acceptance to the superb SDM program and then supporting me all the way through it. Pat Hale has been a shining light to me and to others who have come before me for whom we collectively have immense appreciation. I want to convey a special thanks to Amal Elalam for her extra efforts beyond the call of duty, professionalism, and follow-through in responding to my inquiries before I was accepted into the program and afterwards. Finally, I am very grateful for the professors who have broadened my thinking, along with my cohort with whom I have formed friendships.

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Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Context

The National Intrepid Center of Excellence (NICoE) is the culmination of a 2007 mandate by the U.S. Congress to the Department of Defense (DOD)—to illuminate and target the ever increasing invisible wounds from the wars in Iraq and Afghanistan and affirmatively impact the Military Health System (MHS) [1]. Over 2.2 million U.S. service members have been involved in the Iraq and Afghanistan wars since October of 2001 [2]. According to Weinick et al. [3] from RAND, a screening of 1,965 formerly deployed service members in these wars, the prevalence of the reported "invisible wounds" was 19 percent for Traumatic Brain Injury (TBI), 14 percent for Post Traumatic Stress Disorder (PTSD), and 14 percent for major depression, with five percent indicating all three conditions. Of the 19 percent of TBI reports, 57 percent had been examined by a physician in this regard, and roughly half of the 14 percent of reports involving PTSD or major depression in the last 30 days have engaged with a physician or mental health provider in the past year.

The National Intrepid Center of Excellence [1] provides an overview of the NICoE's genesis. In October of 2010, it commenced with seeing service members with challenging TBI and psychological health (PH) conditions in its newly-built 72,000 square foot facility. The construction and equipping of the facility was managed and funded by the Intrepid Fallen Heroes Fund (IFHF), who raised $65 million in private donations for this effort. It resides on the campus of the Naval Support Activity in Bethesda, Maryland, which is also the location of the Walter Reed National Military Medical Center (WRNMMC) and the Uniformed Service University of Health Sciences (USU).

As far as the NICoE's mission, information is provided in the NICOE Brief to the Recovering Warrior Task Force [4]. The Recovering Warrior Task Force is sponsored by the DOD with an emphasis on the care, supervision, and transition of wounded and sick service members [5]. The mission is stated below:

> As the Military Health System institute dedicated to understanding complex, comorbid traumatic brain injury and psychological health conditions, we deliver comprehensive and holistic care, conduct focused research, and export knowledge to benefit service members, their families and society.

In essence, this mission includes three prongs—clinical care, research, and education. In terms of clinical care, the NICoE provides both diagnosis and treatment of the comorbid TBI and PH conditions through an interdisciplinary approach. Service members who have not responded to previous treatment in the Military Health System (MHS) can be referred to the NICoE and, if they enter into the program, are accompanied by family members during their stay. Concerning research, the NICoE seeks to advance the understanding of the comorbid TBI and PH condition through a combination of technical and clinical research that is gleaned through pilot studies that include service members under treatment. The research prong also involves the NICoE functioning as nerve center for information exchange with U.S. federal and academic colleagues. Finally, education, the third prong, involves the distribution of innovative standards to service providers, as well as the NICoE patients and their families.

To extend the NICoE's clinical prong and relay data in support of the research prong, there are plans for the creation of satellites centers at some military home bases, funded also by the IFHF, with two already opened at Fort Belvoir in VA on September 11, 2013 and Camp Lejeune in NC on October 2, 2013 [1, 6]. Presently, there are an additional seven centers that are under construction or slated to be built at that the following military bases: Camp Pendleton in CA, Fort Bliss in TX, Fort Bragg in NC, Fort Campbell in KY, Fort Carson in CO, Fort Hood in TX, and Joint Base Lewis-McChord in WA [6, 7].

1.2 Motivation

Serving as a Center of Excellence, the NICoE is distinctive in terms of the state-of-the-art clinical services that it delivers and research that it conducts and promulgates. A Center of Excellence is characterized as "an organizational unit that embodies a set of capabilities that has been explicitly recognized by the firm as an important source of value creation, with the intention that these capabilities be leveraged by and/or disseminated to other parts of the firm" [8]. The NICoE's mission is more pervasive in nature relative to extending beyond the DOD to advance the understanding of the comorbid state of TBI and PH from a research perspective. Within the DOD as a Military Treatment Facility (MTF), the NICoE supports, as opposed to supplants, the efforts expended by the other MTFs and service providers who deliver care to service members [9].

The fact that the existence of the NICoE was made possible through the funding of IFHF, a non-profit organization, is another point of distinction. The Intrepid Fallen Heroes Fund [6] provides background information concerning this effort. The Intrepid Foundation, founded by Zachary and Elizabeth Fisher in 1982, served as the basis for the genesis of the IFHF. Through the foundation, the Fishers made personal donations to the families of service members who lost their lives serving their country. This philanthropic work continued through other members of the Fisher family—Arnold Fisher, Richard L. Fisher, and Tony Fisher. As a result of the tragic events of September 11, 2001 and the war in Afghanistan, the Fishers concluded that all Americans should be afforded the opportunity to contribute to this effort, hence the establishment of the IFHF in October 2003.

Subsequent to the opening of the NICoE, the IFHF worked with the U.S. military leadership to determine an appropriate course of action to extend the NICoE's services for service members with TBI, PTSD, and other related conditions. This led to the notion of creating satellite centers that would be located at some of the major U.S. military bases. The satellite centers, called Intrepid Spirit, will focus on the "most advanced care possible" in terms of the diagnosis and

treatment of service members and ensure its continuance within the MHS, as well as support the research efforts at the NICoE.

The type of advanced services that are provided by the NICoE and its satellites to service members is embodied in the notion of holistic care. Holistic medicine views individuals in their entirety with respect to mind, body, and spirit [10]. NICoE's care is patient– and family–focused, and is interdisciplinary, as opposed to multidisciplinary in nature; interdisciplinary care is characterized below:

- Integrates separate discipline approaches,
- Patient intimately involved in discussions and planning,
- Holistic, and
- Patient empowered to have responsibility in their care,

Whereas the multidisciplinary approach involves the following:

- Each discipline approaching from own perspective,
- Treatment prescribed to patient,
- Systems-based care model, and
- Patient recipient of plan [11].

The NICoE epitomizes a holistic approach from what it calls its "Interdisciplinary Model" according to the National Intrepid Center of Excellence [1]. This consists of the "Clinical Care Model," which is indicative of the lifecycle of patient care involving several phases. These include evaluation and then the formation of a treatment plan, which accommodates the specific needs of the patient and is inclusive of care while at the NICoE and beyond. The family members of the service member are involved in these phases. Approaches include the finest care from western, as well as alternative and complementary medicine, and the imparting of mind-body skills. The final phase, discharge, involves communication of a synopsis of the results and recommendations to the service member and family, as well as the relevant personnel within the DOD as appropriate.

The distinguishing characteristics of the NICoE—in particular its mission to provide cutting-edge diagnosis and treatment of service members that can be leveraged DOD-wide, as well as advance research concerning the comorbid TBI and PH conditions—offers an unique opportunity to view the organization from an engineering systems perspective. In fact, Dr. James P. Kelly, the Director at the NICoE, mentioned that "the NICoE should be the rising tide that lifts all boats—it should help the entire MHS further improve its level of sophistication, knowledge, and care it provides our deserving service members" [12].

Crawley et al. [13], distinguished conventional engineering design from that related to engineering systems. Whereas the former places an emphasis on the more concrete characteristics of designing, "such as the technical behavior of a set of elements interconnecting in a certain way," the latter "focuses on a number of abstract concepts first because they provide a general framework for guiding the development of many diverse kinds of systems, so that these systems will provide the desired functions in desired ways." The authors included System Architecture as an example of one of these "abstract concepts" and defined it as an "abstract description of a system and the relationships between those entities."

Nightingale and Rhodes [14] focused on enterprises within the sphere of engineering systems and coined the term *Enterprise Systems Architecting* as an emerging field involving art and science. This is in contrast to the more traditional Enterprise Architecting field with a focus on an information technology view of the enterprise that "works well for the simpler enterprises trying to align processes and technology with organizational structure." In contrast, Enterprise Systems Architecting is broader in scope in terms of enterprise views and is "more integrated with strategy and culture." The authors also specified that enterprises are intricate and integrated, and they must be viewed from a holistic vantage point, as opposed to one that is more reductionist in nature.

Another manner with which to depict the NICoE concerning an enterprise lens is in terms of a Sustainability framework. Due to the NICoE's research emphasis concerning a forward-thinking

understanding of the comorbid TBI and PH conditions, the NICoE's impact is not limited to the organizational structure within which it resides. The research, clinical care, and education emphasis, all entrenched within the NICoE's stated mission, lend themselves to a depiction of the NICoE as an enterprise that can benefit the DOD but also society in general. Sustainability can be defined in various ways. The United Nations [15] provides a universal understanding of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

With respect to a more explicit focus, the United Nations, General Assembly [16] characterized sustainable development in terms of three pillars—social development, economic development, and environmental protection. These pillars were depicted as being "interdependent and mutually reinforcing." Although the focus of the UN has been on sustainable development, these pillars can also be used as a basis for characterizing corporate sustainability [17]. Culture is a missing component of the sustainability landscape and constitutes a fourth pillar [18, 19, 20].

After characterizing the NICoE from an engineering architecting perspective in terms of engineering systems and Sustainability Pillars frameworks, the appropriate aspects of the NICoE that involve replication to its satellites can be identified. Replication is a strategy that involves the notion of knowledge transfer [21], which is defined as the "acquisition from another unit of useful information or practices" and can include adaptation to the firm that is being replicated as a complementary approach [22]. This strategy can be explored to facilitate the replication process of the NICoE to its satellite centers.

In summary, the NICoE offers a unique opportunity for examination as an enterprise, both in terms of enterprise systems architecture and using the Sustainability Pillars framework. This affords the opportunity to examine an enterprise that provides the finest in medical care and research for the benefit of service members and society. First, as a Center of Excellence, the NICoE offers cutting-edge care to service members with comorbid TBI and PH conditions that is

holistic, as well as patient- and family-centric, which can be leveraged for the benefit of the DOD as a whole. This includes an education component to facilitate the dissemination of best practices. Second, the NICoE's leading-edge research, to advance the understanding of the comorbid TBI and PH conditions and act as a hub in this regard, is explicitly stated in the NICoE's mission. This gives credence to the fact that benefiting society, and not just the enterprise itself, is one of its inherent objectives, although an enhanced understanding of comorbid TBI and PH conditions does benefit the enterprise in terms of evaluating and treating services and is thus self-reinforcing. Third, the funding for the NICoE came from the IFHF, which is an example of a societal-focused, non-profit organization acting to fill a gap through the NICoE to target the needs of service members. Finally, this provides an opportunity to not only understand the NICoE as an enterprise, but also how the NICoE can be leveraged to replicate its impact through its satellites.

1.3 Research Overview, Goals, and Questions

1.3.1 Research Overview

The intent of this thesis is to characterize the NICoE from an enterprise system architecting perspective, from this point forward referred to as Enterprise Architecting (EA), and Sustainability Pillars perspectives, including their interrelationships, which is something that has not been observed in the literature. This will provide a holistic enterprise-centric understanding of the NICoE as an entity that services the DOD, through its evaluation and treatment of service members and educational functions that are shaped by its research component, which also benefits society. In addition, it will serve as a basis for understanding how the relevant aspects of the NICoE as an enterprise are leveraged to provide replication of its services through its satellite locations as enterprises in and of themselves. Information found on the satellites in general will be provided; including that which relates to Fort Belvoir, the first satellite the NICoE opened, and thus the longest in operation. Finally, heuristics will be provided to afford guidance on the replication of the NICoE to its satellite centers.

1.3.2 Research Goals

The research goals for this thesis are found below:

- Understand the NICoE's 3-prong mission: clinical care (holistic model of care for diagnosis and treatment of service members), research, and education
- View the NICoE from an enterprise systems vantage point
- Understand how the clinical arm of the NICoE can be replicated to its satellite centers

1.3.3 Research Questions

This thesis addresses the following research questions:

- What are the interrelationships within and across the Enterprise Architecting Views and Sustainability Pillars?
- Can the combined use of EA views and Sustainability Pillars provide a novel framework for examining a health care enterprise?
- Given pertinent aspects of this investigation and replication-related research, can a set of heuristics emerge to recommend guidance on the replication of NICoE to its satellite centers?

Chapter 2

Literature Review

2.1 Comorbid TBI and PTSD Conditions

The NICoE focuses on the comorbid TBI and PH conditions, most notably PTSD [4]. Although reports can vary widely concerning the prevalence of this comorbidity [23], Hoge et al. [24] found that more than 40 percent of service members who lost consciousness during combat also had PTSD, irrespective of the combat experience. As part of a recent longitudinal study involving service members in the Iraq and Afghanistan wars, through use of structured interviews and self-reporting mechanisms, it was found that "even when accounting for predeployment symptoms, prior TBI, and combat intensity, TBI during the most recent deployment is the strongest predictor of postdeployment PTSD symptoms" [25].

As far as TBI, the NICoE evaluates and treats service members who have a mild to moderate classification [26]. The Glasgow Coma Scale (GCS) can be used as a means for accessing TBI according to the Mayo Clinic, since brain injuries generally constitute an emergency and hence need a rapid diagnosis [27]. It includes three sub-scales relative to eye opening, verbal response, and motor response; the scores of the sub-scales are totaled and can range from a low of 3 to a high of 15. A GCS score of 3 to 8 denotes a "severe" brain injury, that of 9 to 12 a "moderate" brain injury, and a GCS of 13 to 15 indicates a "mild" brain injury [28].

According to Lawhorne and Philpott [29], the most prevalent types of TBIs in the Iraq and Afghanistan wars are in the mild to moderate range, due to the equipment that is worn by service members to protect their head. Blast injuries are the most common types of injuries in

combat, which result from improvised explosive devices. The authors specify that these types of injuries are caused by the following types of blast dynamic forces:

- Primary Blast: atmospheric overpressure followed by underpressure or vacuum
- Secondary Blast: objects placed in motion by the blast hitting the service member
- Tertiary Blast: service member being placed in motion by the blast
- Quaternary Blast: other injuries from the blast such as burns, crush injuries, toxic flames

As far as PTSD, the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [30] provides a methodology for diagnosis. The high-level diagnostic criteria for PTSD are found below:

A. Exposure to actual or threatened death, serious injury, or sexual violence
B. Intrusion symptoms associated with traumatic (events), beginning after the traumatic event(s) occurred
C. Persistent avoidance of stimuli associated with the traumatic event(s), beginning after the traumatic event(s) occurred
D. Negative alterations in cognitions and mood associated with the traumatic event(s) beginning or worsening after the traumatic events occurred
E. Marked alterations in arousal and reactivity associated with the traumatic event(s), beginning or worsening after the traumatic event(s) occurred
F. Duration of the disturbance (criteria B, C, D, and E) is more than 1 month
G. The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning
H. The disturbance is not attributable to the physiological effects of a substance (e.g., medication, alcohol) or another medical condition

Criteria A through E are further divided to facilitate the diagnosing process.

TBI and PTSD have both distinct and overlapping symptoms as shown in Figure 1.

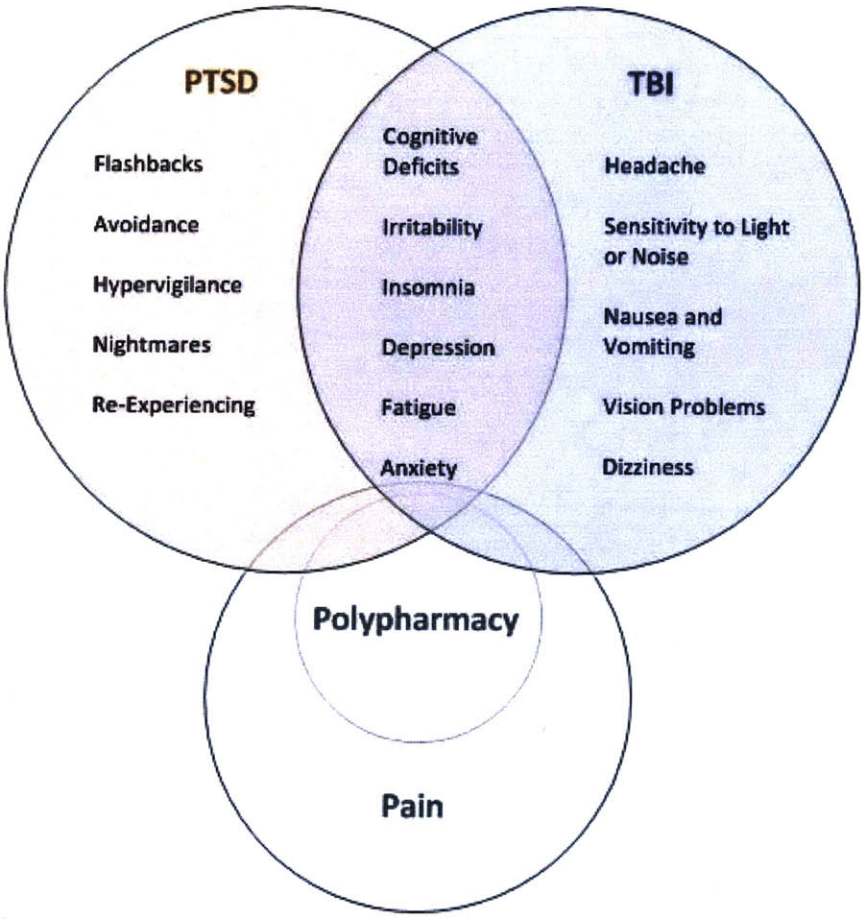


Figure 1: PSTD and TBI Symptoms – adapted from [26]

The common symptoms for both PTSD and TBI are the following: cognitive deficits, irritability, insomnia, depressions, fatigue, and anxiety. Pain and polypharmacy are associated with both conditions, with the later referring to using multiple drugs for treatment [31]. With respect to veterans that were engaged in combat, a significant association has been found between mild TBI, PTSD, depression, and physical health symptoms, which supports an interdisciplinary approach to treatment [24], such as that which is used by the NICoE.

2.2 The NICoE–related Research

Illustrations of the NICoE–associated research provide information on the NICoE as an organizational entity, as well as indication of its research protocols, collaborative efforts, and research published in peer-related journals. In terms of an organizational perspective, the NICoE was characterized by Weinick et al. [3] from RAND, which identified and described all DOD funded or sponsored programs that target TBI and PH, as well as provided recommendations across the programs. The term "program" in the study was defined as follows:

> "Program" is used to describe entities that provide active services, interventions, or other interactive efforts to support psychological health, as well as care for service members (and their families) who are experiencing such problems as PTSD, anxiety, depression, and TBI. Programs are distinct from clinical care services (e.g., mental health services, clinical services for physical health problems) and non-clinical services (e.g., services provided in chaplaincy or community and family support departments, including other services unrelated to psychological health and/or TBI).

A total of 211 organizational entities within the DOD that were active from December 2009 to August 2010 met this classification as a "program." Table 1 lists all of the characteristics that RAND used to describe the programs, along with an indication of how the NICoE was portrayed.

Table 1: Program Characteristics that are Inclusive and Exclusive of NICoE [3]

	Characteristic of the NICoE	Not Characteristic of the NICoE
Branch of Service	DOD-wide	Specific to Army, Army Reserve, Army National Guard, Air Force, Air Force Reserve, Air National Guard, Navy, Navy Reserve, Marine Corps, and/or Marine Corps Reserve
Targeted Participants	Service members and family members	Veterans

	Characteristic of the NICoE	Not Characteristic of the NICoE
Deployment Phase	Not related to deployment phase	Pre-deployment, deployment, re-deployment, and/or post-deployment
Domain	Biological, psychological, social, spiritual, and holistic	*none*
Approach	Education/training, prevention/resilience, and outreach	*none*
Clinical Issues	PTSD, TBI, and general psychological health	Depression, substance abuse, and/or suicide prevention
Non-clinical Issues	*none*	Deployment-related, domestic violence, family and/or children, legal, relationships, resilience, spiritual, stress reduction, and/or other
Evidence Base, Evaluation Status, and Data Collected	Evidence-based intervention, and process and outcome data currently collected by program	Outcome evaluation conducted in past 12 months

From a clinical orientation, the results convey that the NICoE addresses PTSD, TBI, and general PH, but not issues related to depression, substance abuse, and suicide prevention. Also the domains employed to treat these conditions include all that were used to characterize the programs—biological, psychological, social, spiritual, and holistic. Finally, the NICoE uses evidence-based intervention and collects both process and outcome data. Although the program characteristic "outcome evaluation conducted in past 12 months" was not indicated, the NICoE was a relatively new program at the time of the study, since it began seeing patients in October of 2010 [1].

As far as the NICoE's collaborative efforts, examples include partnerships with the University of Southern California's (USC) Institute for Creative Technologies (ICT) and the National Endowment for the Arts (NEA). Concerning the former, the Coming Home [32] website of the University of Southern California (USC), Institute for Creative Technologies (ICT), describes a virtual version of the NICOE that service members can access while being treated at the NICoE and afterwards. The virtual space affords connectivity to the NICoE, as well as access to instructive materials and activities that are provided by its departments. This is part of a larger project involving the use of virtual worlds in telehealth [33]. The NICoE's collaboration with the NEA [34] involves their delivery of neurologic music therapy to the NICoE and the investigation of the association between music and PH. This partnership has also included the incorporation of an adapted version of the NEA's expressive-writing program called Operation Homecoming and the study of associated patient outcome measures.

As far as research protocols, the initial protocol approved at the NICoE involved an investigation of functional magnetic resource imaging (fMRI) in relation to blast-related TBI [35], with the NICoE review in this regard published recently [36]. As stated by the NICoE Brief to the Recovering Warrior [4], other examples of research protocols are found below:

- Pathophysiology of Comorbid TBI/PH
    - Predictors of PTSD & Post Concussive Syndrome in OIF/OEF [Operation Enduring Freedom/Operation Iraqi Freedom] Veterans
    - The NICoE Clinical Research Database to Study the Natural History of TBI and PH Outcomes in Military Personnel
- Improving Diagnosis
    - Differential Assessment of mild TBI (mTBI) and PTSD Using Functional Brain Imaging Techniques (magnetoencephalography (MEG) and (MRI))
    - Assessing the Impact of mTBI on Multisensory Integration While Maneuvering on Foot
- Improving Treatment

- Enhancing Exposure Therapy for PTSD: Virtual Reality and Imaginal Exposure with Cognitive Enhancer
- The ViRTICo-DP Trial: Virtual Reality Therapy and Imaging in Combat Veterans with Blast Injury and PTSD

The NICoE Brief to the Recovering Warrior [4] provided data relative to the active number of studies in FY2012 as follows: 3 studies are under development, 2 studies are pending an Institutional Review Board (IRB) review, 13 studies are in data collection, 9 articles in peer-related publications, along with 30 poster/podium presentations. Currently, recruitment is underway for a research study involving service members with possible PTSD who served in Iraq or Afghanistan [1]. The study is to determine if a FDA-approved drug for conditions not including PTSD combined with exposure therapy can improve PTSD treatment.

In relation to characterizing the severity of TBI, the NICoE initiated an investigation, called the Neuroimaging Common Data Element Validation Study, to clarify the relationship between MRI brain abnormalities and behavioral issues [37]. The goal was to provide a more granular and standardized way to characterize brain injuries from MRIs than the typical broad classification of mild, moderate, or severe TBIs and notations as the result of radiology reviews. In this way, physicians could more readily associate TBIs with potential cognitive issues. As a result, the NICoE developed an online system for descriptively representing TBIs in a standardized manner, as well as a means for generating reports to provide feedback on incongruities in their results.

In terms of latent TBI issues, the NICoE study by Temme et al. [38] involved inducing hypoxia to uncover memory as well as other cognitive deficits. In this study, a breathing machine device was used that mimics reduced oxygen levels at altitude (18,000 feet above sea level). The results showed that short-term visual memory was compromised in instances involving hypoxia, which was not observed under normal circumstances. Other investigations to characterize TBI have involved the use of various types of imaging systems [39, 40, 41], as well as integration of computer-aided diagnosis systems (CADs) with clinical data from electronic health records [39].

2.3 Enterprise Architecting from an Engineering Systems Perspective

According to Nightingale and Rhodes [42] enterprise architecting is a subfield of Engineering Systems, which is "an emerging field of scholarship that seeks solutions to complex socio-technical challenges, applying approaches from engineering, social sciences and management." Within the realm of enterprise architecting, the authors note that an enterprise can be characterized from the perspective of eight architectural "views," as shown in Figure 2. Each "view" or "lens" provides a means to magnify a certain area of the enterprise for further scrutiny or emphasis, a way to diminish complexity so that an understanding of the entire enterprise can be realized, and vantage points from which the distinctive needs of the stakeholders of the enterprise can be understood. There also exists a relationship between the views such that "some views drive or determine the architectures and the required attributes of other views" [43].

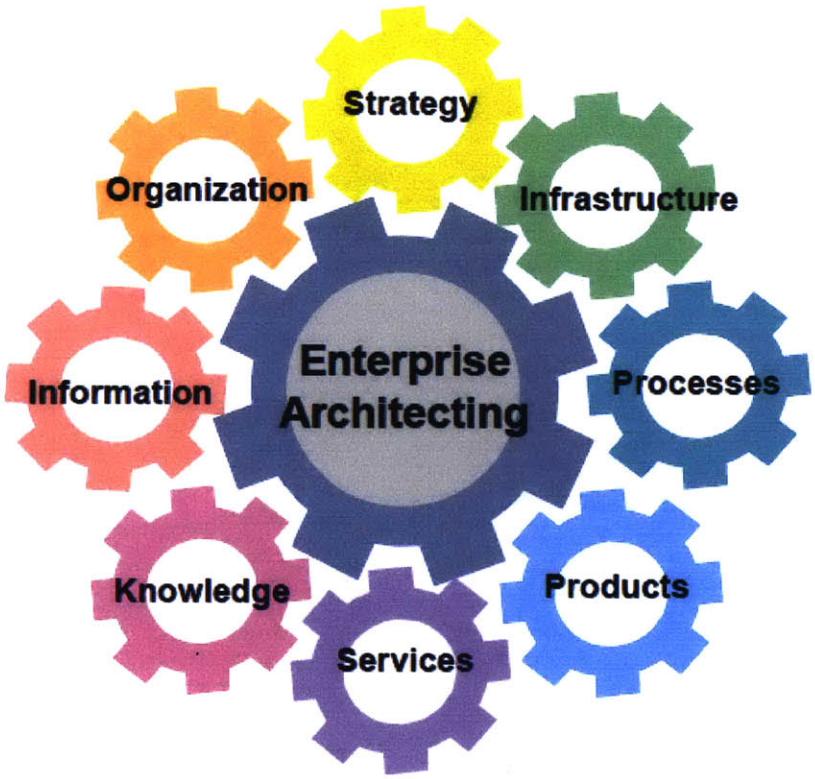


Figure 2: Enterprise Architecting Views [42]

Nightingale and Rhodes [44] define the architecting views as follows:

- **Strategy**: the vision, strategic goals, business model, and enterprise level metrics
- **Process**: Core leadership, lifecycle and enabling processes by which the enterprise creates value for its stakeholders
- **Organization**: the culture, organizational structure, and the underlying social network of the enterprise
- **Knowledge**: the competencies, explicit and tacit knowledge, and intellectual property resident in the enterprise
- **Information**: the available information required by the enterprise to perform its mission and operate effectively
- **Infrastructure**: systems and information technology, communications technology, and physical facilities that enable enterprise performance
- **Product**: the products that the enterprise acquired, markets, develops, manufactures, and/or distributes to stakeholders
- **Services**: the offerings derived from enterprise knowledge, skills, and competencies that deliver value to stakeholders, including support of products

Team members from the MIT Sociotechnical Systems Research Center [45] project entitled "Post-Traumatic Stress Innovations: U.S. Military Enterprise Analysis" (of which the author of this thesis is also a member) have generated theses that have included these enterprise architecting views for analysis and, ultimately, enterprise transformation purposes. The project is a "three-year grant cooperative agreement" from October 2011 through January 2015 and involves creating "recommendations for architecting a more effective and efficient future military psychological health care system related to post-traumatic stress in support of service members and their families."

Ippolito [46] authored the first thesis called, "Architecting the future telebehavioral health system of care in the United States Army." It involved the use of enterprise views (e.g., strategy,

policy, organization, services, processes, infrastructure, and knowledge) to evaluate the current state of telehealth within the MHS in order to provide a transformative future-state enterprise in terms of telehealth delivery. Requirements were identified that must be addressed in order for emergence of the future state enterprise.

The second thesis was authored by Ciley Southerlan [47] and entitled "Using Enterprise Architecting to Investigate a Complex, Multilevel Enterprise and Create a Framework for Enterprise Transformation." This thesis involved two objectives. The first objective was to ultimately aide in the genesis of a future state Military Psychological Health Enterprise (MPHE) by using enterprise architecting views to examine the current state of MPHE through an investigation of Camp Lejeune, a Marine Corps base located in North Carolina. The second objective involved the use of multilevel analysis to generate a framework that facilitates transformation of the MPHE through the examination of Camp Lejeune, and ultimately other complex organizations.

2.4 Sustainability Pillars

The three Sustainability Pillars that were mentioned by the United Nations [16], the social, economic, and environmental pillars, can be used to characterize a healthcare system. After a literature review, Faezipour and Ferreira [48] identified six major groupings that can be leveraged to portray a sustainable healthcare system (see Figure 3).

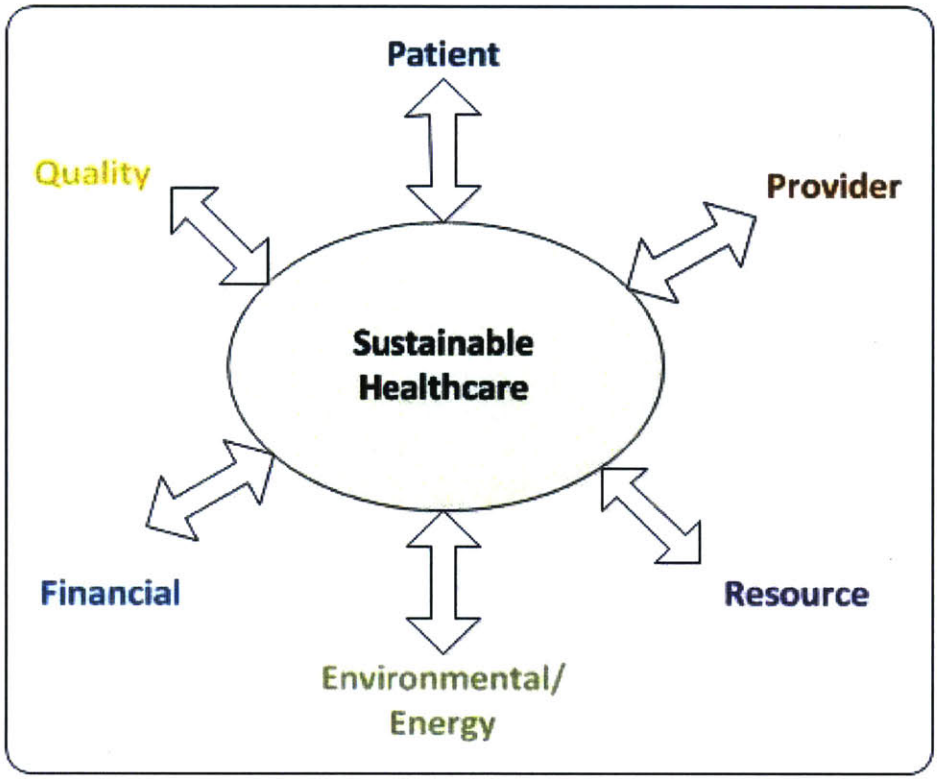


Figure 3: Major Groupings in Sustainable Healthcare – adapted from [48]

These groupings included the following: patient, provider (healthcare staff, insurance providers etc.), resource (e.g., healthcare facilities, medication, etc.), quality (patient satisfaction, effectiveness and efficiency of services, factors related to the staff, etc.), financial (cost of services of services provided to patients and their payment), and environmental/energy (energy ingested by facility and equipment). These groupings can be subsumed, more or less, into the three Sustainability Pillars as shown into Table 2.

Table 2: Sustainable Healthcare Groupings relative to Sustainability Pillars [48]

Sustainable Healthcare Grouping	Primary Sustainability Pillar	Other Sustainability Pillar
Patient	Social	
Provider	Economic	Social
Resource	Economic	Social

Sustainable Healthcare Grouping	Primary Sustainability Pillar	Other Sustainability Pillar
Environmental/Energy	Environmental	
Financial	Economic	
Quality	Social	Economic

For example, the authors note that Patient and Quality belong to the Social pillar, but that Provider and Resource can also be associated, in part, with this pillar. Further, all of these groupings are interrelated in some respects.

Although it is more conventional to portray sustainability in terms of the three pillars as mentioned above, a fourth pillar has been identified as being a viable addition [18, 19, 20]. A depiction of the four Sustainability Pillars is found in Figure 4.

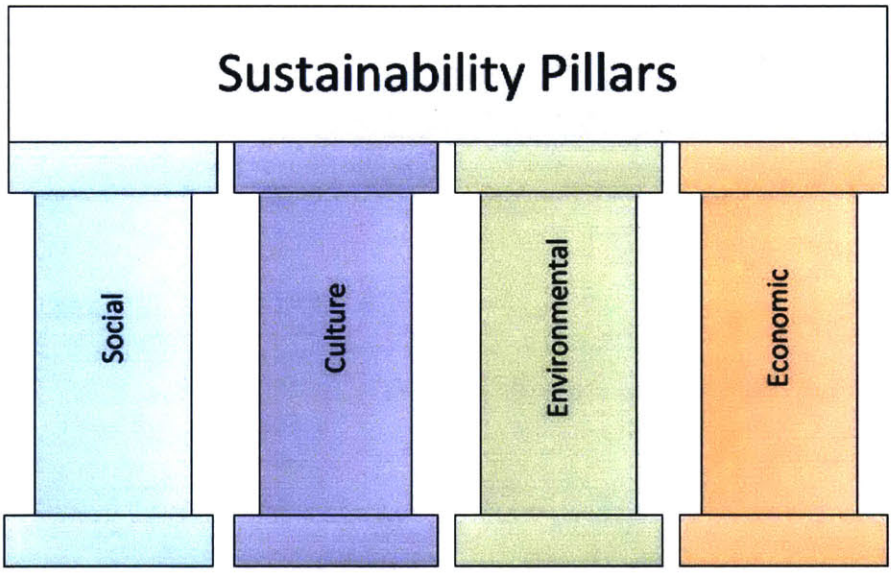


Figure 4: The Four Sustainability Pillars

When describing concepts related to social sustainability, Bostrum [49] includes culture by stating that "notions of social sustainability often refer to such aspects as social welfare, quality of life, social justice, social cohesion, cultural diversity, democratic rights, gender issues, worker's rights, broad participation, development of social capital and individual capabilities,

and so forth." On the other hand, Hawkes [19] argues for including culture as a fourth sustainability pillar, as sustainability is a discourse about values that involves culture. The author indicates that there are two preeminent definitions concerning culture as follows:

- the social production and transmission of identities, meanings, knowledge, beliefs, values, aspirations, memories, purposes, attitudes and understanding
- the 'way of life' of a particular set of humans: customs, faiths and conventions; codes of manners, dress, cuisine, language, arts, science, technology, religion and rituals; norms and regulations of behaviors, traditions and institutions

Hence culture relates to an individual's values and identity, as well as that of the particular milieu in which they live, and is distinguished from the social pillar of sustainability, which envelops notions of social justice and human rights.

2.5 Replication through Knowledge Transfer

According to Baden-Fuller and Winter [50], the replication of information and activities from one firm to another is "fundamentally about knowledge transfer," and accomplished through some degree blending the *principles* and *templates* approaches. The templates approach is focused on duplicating the processes of the replicator firm, whereas the principles approach conveys why things are accomplished in a certain manner and leaves implementation up to the person. The authors offer further elaboration as follows:

> The guidance provided by "Principles" has the flavor "Let me explain *why* this works and the *reasons why* I do it this way and then try to make it work yourself—I will comment on any mistakes I see." The "Templates" approach is suggested by "Watch very carefully *how* I do this; then copy *what* I do and try hard to copy it exactly—but don't ask me *why*." The word *why* is clearly central to this distinction, being at the core of one approach while often considered a pitfall in the other. The implied attitude toward the details of "how" is correspondingly different, with the principles approach suggesting that they should be determined (learned or invented) by the recipient, and the templates view being that they are provided by the source – in fact, they may be the

main thing the source has to offer. Although both approaches are typically at work in replication processes, the emphasis can lie strongly to the one side or the other. Both approaches involve codification or a "how-to" orientation, with the principles approach focusing on imparting understanding and the templates approach emphasizing a procedural means for knowledge transfer. The templates approach has more of an emphasis on codification, which can exclude the conveyance of some tacit knowledge that depends on the context of the working environment.

With respect to a template approach, replicating best practices that are implemented successfully in one organizational entity for knowledge transfer to another requires the generation of a single template that is tactical and adaptive in nature (i.e., changes are made when supported by results, or when the transfer of knowledge is not working due to imperfections in the template including lack of accommodation to local differences); in addition to knowledge transfer, the template should include success measures along with a structured means for attainment [51].

On the other hand, Guttel et al. [52] advocates the use of a principles-related approach for replication, one that is complementary in nature to that which employs templates, through artifacts that convey the boundary between admissible and unacceptable departure from conventional practices that tend to be structured. On the part of the replicated organization, this also provides a means for behavior that offers exploration, which promotes a more adaptive approach to conditions requiring acute responsiveness. Concerning the case study that was used as an example, the artifacts of the company that included codified rules are below:

- Operational procedures
- Innovation procedures
- Interaction procedures
- Training procedures

The codified knowledge included information concerning terminology used and history of the industry, along with information on strategy and culture. The codified rules combined with codified knowledge provided an identifiable means for exploration and innovation.

Williams [22] includes the notion of *adaptation* in addition to *replication* in relation to knowledge transfer. Replication is essentially a duplication of knowledge from the replicator to the replicated firm, whereas adaption emphasizes modifying the knowledge for conformance to the latter. The author notes that "firms need to differentiate between ambiguous knowledge, which must be copied exactly, and knowledge that is intertwined within the environment, which requires modification" and that "while exact copying of knowledge is difficult in new settings, effort invested in copying will significantly increase the transfer of valuable knowledge even if perfect copying is not approved." In addition, considerations for adaption also exist between the intersection areas between unclear knowledge and the organizational setting of the replicated firm.

Chapter 3

Enterprise Architecting and Sustainability Pillars Examination of the NICoE

3.1 Overview

A condensed version of the eight Enterprise Architecting (EA) "views" or "lenses" and the four Sustainability Pillars that were described in Chapter 2—moreover the interrelationships among the abridged lenses and pillars, between the lenses themselves, and among the pillars themselves—will be used to characterize the NICoE and its satellites from a systems perspective. The tailored version of the Enterprise Architecting views are based on a determination made by MIT research members of the "Post-Traumatic Stress Innovations: U.S. Military Enterprise Analysis" research project [45], for which this thesis is a contribution, to customize the views for the purposes of the project. The four abridged views and their descriptions are found in Table 3.

Table 3: Enterprise Architecting Views and their Components

Enterprise Architecting View	Component
 **Policy/Measurement**	Policy Measurement Governance Metrics
 **Organization/Culture**	Organizational Structure Culture Knowledge Sharing Practices

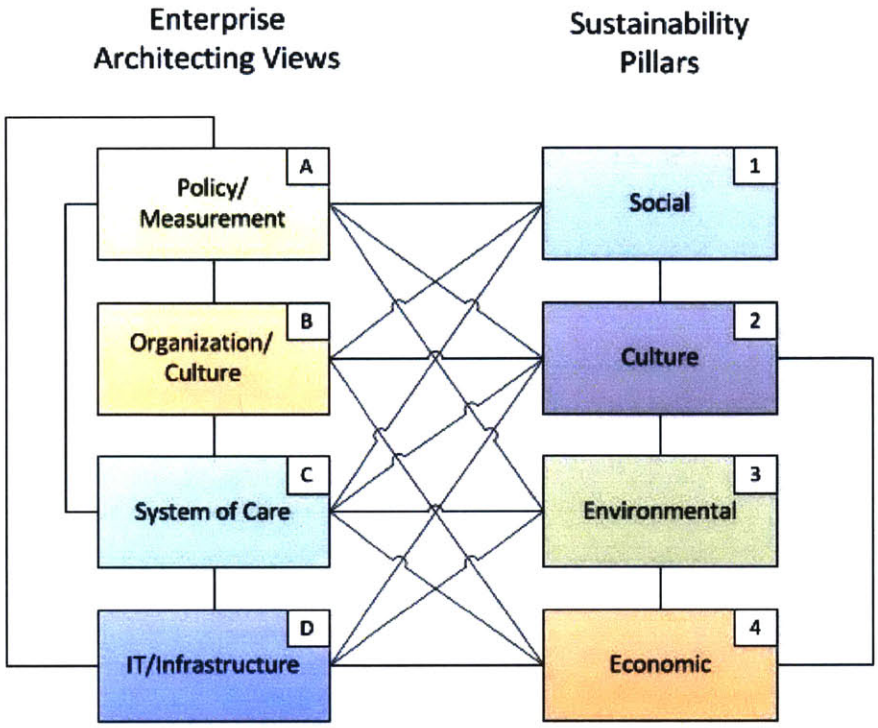
Enterprise Architecting View	Component
 **System of Care**	Staffing Healthcare personnel Processes Care delivery (in- and out-patient care)
 **IT/Infrastructure**	Information technology (IT) Infrastructure Facilities Spatial Accessibility Evolving technology

According to Nightingale and Rhodes [42], the eight views (which are now encapsulated in four views for the purpose of this study) are encased within an ecosystem that includes both internal and external stakeholders. The ecosystem, stakeholders, and eight views comprise a ten element framework with which to characterize an enterprise's architecture. For the purpose of this study, the relevant aspects of the NICoE's ecosystem, as well as its stakeholders, will be highlighted throughout the characterization of the NICoE using the four EA lenses and Sustainability Pillars. The first part of this chapter will focus on the EA views, the second on the Sustainability Pillars, and the third on the interrelationships between the two. For reference, a list of acronyms used in this thesis is found in Appendix A.

3.2 The NICoE Characterization by the Enterprise Architecting and Sustainability Pillars

To represent the distinctive qualities of the NICoE as an enterprise from a systems perspective, the EA views and the Sustainability Pillars can be employed. The use of these frameworks can be leveraged to capture the NICoE's cutting-edge emphasis in terms of healthcare and research concerning the comorbid TBI and PH conditions. Specifically the NICoE is depicted according to the EA views of Policy Measurement, Organization/Culture, System of Care, and IT/Infrastructure and the interrelationships among these views. Likewise the NICoE is portrayed from the vantage point of the Sustainability Pillars and their interconnections, which involves the Social, Cultural, Economic, and Environmental aspects of an enterprise. Further, the

interrelationships between the EA lenses and Sustainability Pillars are indicated to glean an understanding of the NICoE as a whole in terms of these two frameworks. A rendition of the frameworks, as well as all of the interrelationships therein, is shown in the Figure 5 and will be discussed in the succeeding sections.



Enterprise Architecting Views

A-B	Knowledge sharing for impacting quality of care
A-C	Measures for clinical care
A-D	Measures for facility design
B-C	Knowledge sharing for service members and family
C-D	Facilities and advanced technology for influencing clinical care

Sustainability Pillars

1-2	Research for impacting clinical care; stigma for getting help in military and society in general
2-3	LEED design for impacting clinical care
2-4	IFHF and Fisher House Foundation and patient-centered care for influencing costs
3-4	LEED design for impacting cost

Enterprise Architecting Views and Sustainability Pillars

A-1	Research for impacting quality of care
A-2	Measures for facility design
A-3	Measures relating to LEED certification
B-1	Knowledge sharing for outreach
B-2	Diversity in organizational structure and clinical care
B-4	Costs for education
C-1	Research for impacting society
C-2	Clinical care for impacting stigma and related to customized care
C-3	LEED design for impacting clinical care
C-4	Costs for clinical care and research
D-2	Facility design for influencing stigma and clinical care
D-3	Facility design and LEED
D-4	IFHF and Fisher House Foundation for influencing costs

Figure 5: Enterprise Architecting Views and Sustainability Pillars, and their Interrelationships

Coverage will include segmenting the information found on the NICoE into the EA view or Sustainability Pillar that constitutes a best fit.

3.2.1 Enterprise Architecting Views and their Interrelationships

3.2.1.1 Policy/Measurement EA View

In relation to the NICoE, the Policy/Measurement EA view is comprised of the strategy and the measurement aspects of the enterprise. According to the NICoE Brief to the Recovering Warrior Task Force [4], imperatives that align with the enterprise's five-year strategic plan are to "advance the understanding of the comorbid TBI/PH disease state in order to improve diagnosis and treatment" and to "influence improvements in the quality of care through partnerships across the MHS, VA, and civilian sector," which are indicative of the ecosystems within which the NICoE resides along with some of its stakeholders. The imperatives relate to the overall mission of the NICoE of positioning itself at the forefront of understanding and addressing the comorbid conditions of TBI and PH through its three-prong mission involving clinical care, research, and education [1].

With respect to measurements, Weinick et al. [3] from RAND characterized the NICOE as engaging in evidence-based practices and collecting process and outcome information. The NICoE Brief to the Recovering Warrior Task Force [4] provides an indication of the measurements that are used at the NICoE, including patient satisfaction scores and patient feedback. In terms of clinical evaluations, the following are performed pre- and post-treatment at the NICoE:

- Satisfaction with Life Scale (SWLS)
- Neurobehavioral Symptom Inventory (NSI)
- Epworth Sleepiness Scale
- PTSD Check List-Military (PCL-M)
- Dizziness Handicap Inventory (DHI)
- Headache Impact Test (HIT)

The results of these tests are found in Table 4, with each indicating an improvement in scores from admission to discharge.

Table 4: Admission and Discharge Scores of the NICoE Patients [4]

Outcome Measure	Number of Patients	Admission Mean (Stand. Dev.)	Discharge Mean (Stand. Dev.)	p-value
SWLS	181	3.98 (1.84)	4.65 (1.67)	<0.001
NSI	178	46.04 (16.90)	35.13 (17.99)	<0.001
Epworth	181	10.38 (6.08)	9.31 (5.60)	.002
PCL-M	179	55.08 (15.59)	44.25 (18.33)	<0.001
DHI	47	44.62 (28.25)	37.11 (29.10)	<0.001
HIT	182	61.87 (08.15)	58.01 (8.72)	<0.001
NSI score for headaches	115	3.10 (.816)	2.81 (.76)	.001

Scores were also amassed concerning the patient experience of clinical care at the NICoE, resulting in an overall patient satisfaction score of 95%. In terms of patient feedback, the following items were mentioned:

- Positives: team approach; team takes time to listen to me and they care
- Negatives: program needs to be longer; concern that they will return to care as usual

Although evidence-based treatments are provided to the patient during their four-week stay at the NICoE, a completed treatment program cannot be rendered, and so the NICoE communicates with and ensures accountability from the referring service provider in terms of reporting the types of treatment used and patient's progress after returning to their home base [4]. Metrics will also cover aspects related to the NICoE's innovative building design (e.g., effect of lighting, noise, etc.) and number of program-related measures including the effect of family participation, patient compliance with treatment-related activities (e.g., the arts) and how they relate to TBI- and PTSD-related results and other measures [53].

Another dimension in terms of metrics is the number of patients who participate in the NICoE program. From October 2010 through August 2012, the NICOE has seen 329 patients—107

Marines, 142 Army, 64 Navy, and 16 Air Force [26], with the number of patients that the NICOE can accommodate per year at 250 [54].

3.2.1.2 Organization/Culture EA View

The Organization/Culture EA lens relates to the NICoE's organizational structure and the knowledge sharing of the Education prongs of its mission. In August 10, 2010, the NICoE was transferred to the Department of Navy for alignment under the National Naval Medical Center (NNMC) [55]. However, the U.S. Base Realignment and Closure Act (BRAC) of 2005 resulted in the closure of both the NNMC and the Walter Reed Army Medical Center, as well as the emergence of the Walter Reed National Military Medical Center (WRNMMC) with the stated objective as follows:

> As Army, Navy, Air Force and Uniformed Services University healthcare systems join together we continue to combine and respect our diversities and unique individual histories while reaping the benefits of a strong, united and energetic entity. Walter Reed National Military Center, Bethesda is today a single entity committed to a mission that we are honor-bound to pursue; that of providing world class healthcare to our nation's fighting forces, retirees, and their family members [56].

Thus the NICoE reports to the WRNMMC [26] with a culture that atypically includes multi-branch inclusion. Presently, within the WRNMMC, Sara M. Kass, M.D. serves as the NICoE Special Assistant to the Commander, and James P. Kelly, M.D. is the Director, with Thomas J. DeGraba, M.D. serving as Deputy Director, Chief of Medical Operations and Walter Greenhalgh, M.D. as Chief of Clinical Operations [1]. The above personnel comprise the NICoE's stakeholders in terms of leadership functions.

With respect to the NICoE's ecosystem, the WRNMMC is an entity in a newly-formed organizational structure called the Defense Health Agency (DHA), which emerged as part of a governance reform effort by the DOD for increased integration of services [57], with the

organizational entities that represent only the direct hierarchical reporting structure relative to the NICoE found in Figure 6:

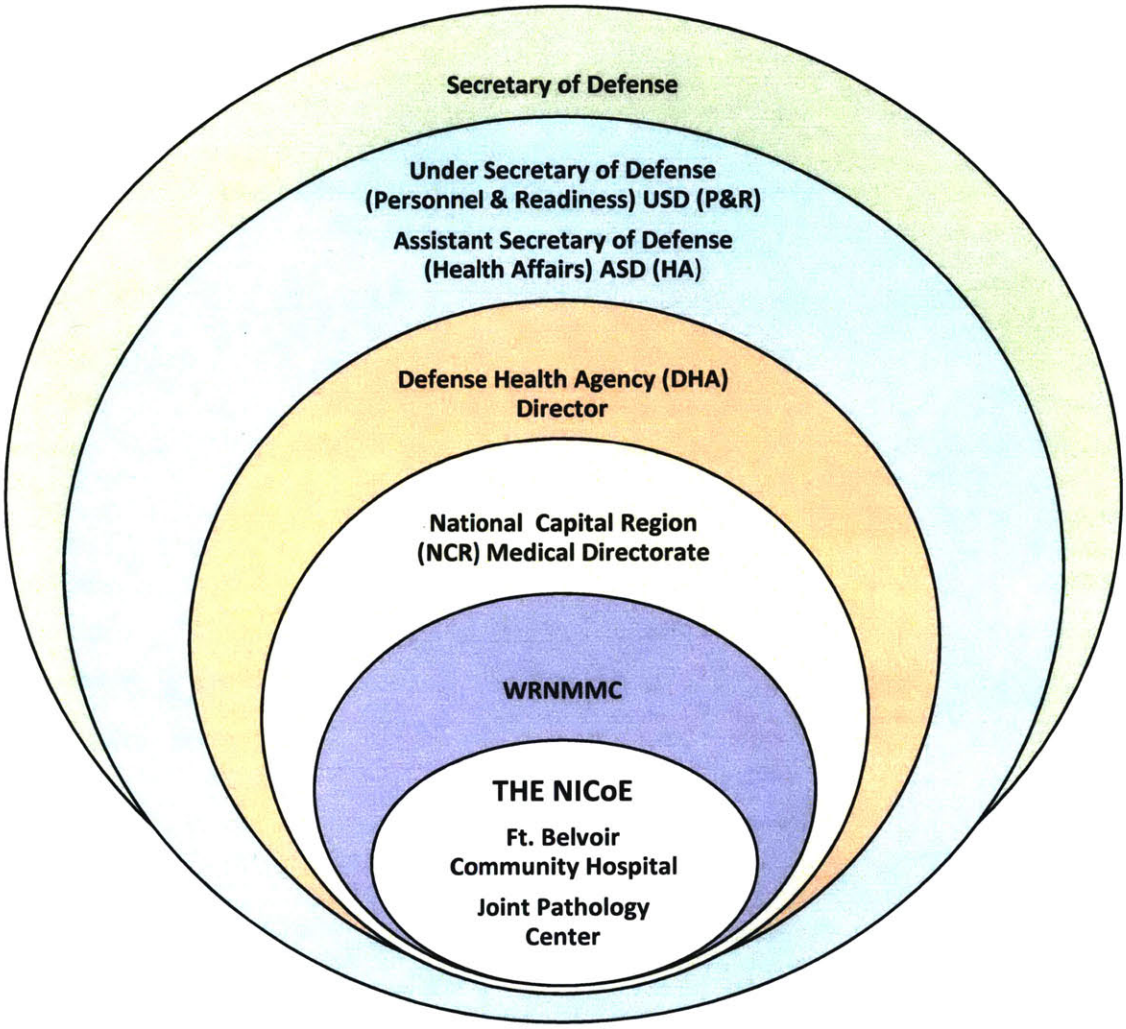


Figure 6: The NICoE-related Reporting Structure within the DOD – adapted in part from [57]

The NICoE, Ft. Belvoir Community Hospital, and the Joint Pathology Center report to the WRNMMC, which in turn reports to the NCR Medical Directorate, and so on.

The knowledge-sharing aspects of the NICoE are achieved primarily through the education prong of its mission. According to the NICoE Brief to the Recovering Warrior Task Force [4], there are a number of ways in which the NICoE is dispensing knowledge. For instance, the staff

at the NICoE is developing in excess of 40 hours of skill-based wellness modules and self-management modules for participatory service members and families. The NICoE has also partnered with First Lady Michelle Obama and Dr. Jill Biden as part of their Joining Forces initiative "dedicated to connecting our servicemen and women, veterans and military spouses with the resources they need to find jobs at home" to embolden distribution of the curriculum for TBI education to health programs across the nation [58]. In this same vein, the leadership of the NICoE has conducted train-the-trainer sessions for health education centers in different areas of the country. The number of conferences and training seminars that the NICoE has hosted since its opening is 123. Conferences have included the Center for Disease Control Concussion Definition Working Group and MIT's Regeneration of Brain Synapses—Science, Implications, and Opportunities.

Another manner in which the NICoE disseminates its knowledge is through an Extension for Community Healthcare Outcomes (ECHO) project. The ECHO platform, involving cutting edge telehealth technology, was developed by the Health Sciences Center at the University of Mexico as a means to train primary care providers, on best practices in their respective areas using instruction and case studies, for enhanced delivery of specialized care in locations of need [59]. The NICoE uses ECHO to share their clinical knowledge of TBI and PH, with those delivering clinical care, to foster the growth of a network with its satellites. Each session involves case study and instructive-style presentations. Feedback is amassed from the service providers at the session and six months afterwards to determine how the ECHO session impacted their practice.

3.2.1.3 System of Care EA View

The System of Care view essentially concerns the Clinical Care and Research prongs of the NICoE's mission in terms of staffing, services, and processes. The primary stakeholders in the Clinical Care prong include the patient, family, and staff. The staff includes the following team members, with a Primary Care Physician as the team leader reflecting the interdisciplinary approach that is employed at the NICoE [1]:

- Radiologist
- Assistive Technologist
- Audiologist
- Speech-Language Pathologist
- Neurologist
- Neuropsychologist
- Physical Therapist/Occupational Therapist
- Nurse
- Physiatrist (physical medicine and rehabilitation)
- Nurse
- Physiatrist (physical medicine and rehabilitation)
- Chaplin
- Family Therapist
- Optometrist
- Ophthalmologist
- Psychiatrist
- Recreational Therapist
- Clinical Pharmacist

As of December 18, 2012, the size and composition of the NICoE's staff [4] is found in Table 5.

Table 5: Size and Composition of the NICoE Staff [4]

	Vacant	Filled	Total
Administration	6	9	15
Clinical	9	44	53
Research	7	15	22
Material and resources	4	1	5
Education	3	7	10

With respect to the 44 clinical staff members, roughly 0.15 FTEs are dedicated to conducting research with the objective of increasing this to 0.25 FTEs.

The staff is involved in the patient or service member's clinical care. A typical patient profile according to NASHIA et al. [26] involves "active service members with a mild to moderate TBI complicated by other impairing PH conditions, who are not responding to conventional therapy and who are having challenges with military duty requirements and interpersonal relationships." This includes National Guard and Reservists if orders exist to that affect. Patients

must not have any active or untreated issues related to substance abuse. They are assigned temporary duty to the NICoE during their stay with lodging provided at the Fisher House at no charge. Additional qualifications for entry into the NICoE as stated by the NICoE update follow:

- Able to perform all Activities of Daily Living (ADLs) and live independently in a Fisher House
- Able to independently obtain/provide for their own food, transportation and conduct their own financial affairs
- Not a danger to self or others
- Not in need of services requiring a level of nursing care or medical monitoring higher than what can safely be provided in an outpatient setting

Family members are an active part of evaluation and treatment aspects of the service member's clinical care. "Family" in this sense are inclusive of "spouses and children, non-beneficiary parents of single service members, significant others and caregivers or close supportive friends who might not otherwise be eligible for participation in DoD health programs as a family member [1]. They also stay at the Fisher House at no cost [6].

The primary process for referral to the NICoE is through the service member's primary care managers (herein referred to as service provider). Sample types of service providers, also included as the NICoE stakeholders, involve the service member's primary care manager, neurologist, psychiatrist, and Emed (emergency medicine) [4], with the process shown in Figure 7:

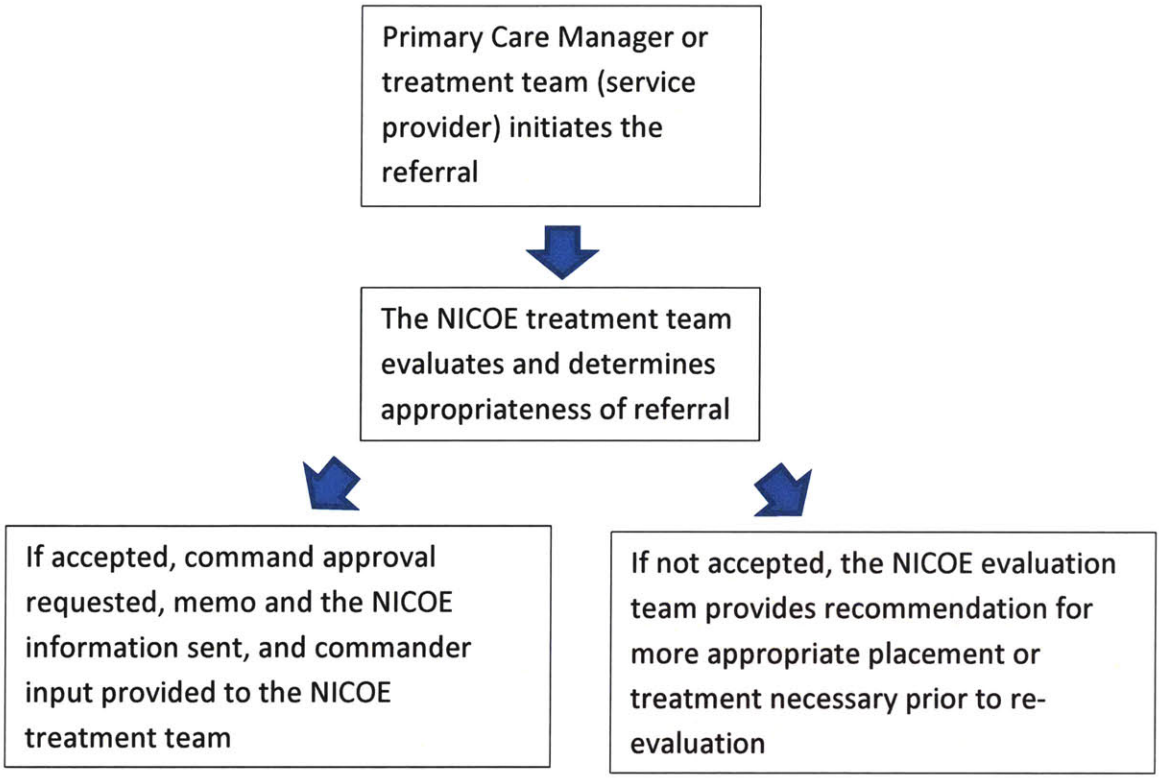


Figure 7: The NICoE Referral and Approval Process – adapted from [4]

After the acceptance and approval process is affirmative, the evaluation and treatment program commences for the service member and their family. The NICoE works closely with the service provider during the service member's stay at the NICoE as part of the diagnostic and treatment configuration process. This continues long-term after the service member exits the NICoE from which follow-up is provided to the service provider as previously mentioned [60].

As far as the services provided to service members in terms of holistic clinical care, NASHIA et al. [26] provides information on the goals for diagnosis and treatment, the typical activities involved, and an example of what patients and their families might experience during each week of their four-week stay at the NICoE is found in the Appendix. The goals for treatment of the patient are divided into three types of categories, labeled Goal Set 1, Goal Set 2, and Goal Set 3 as depicted in Table 6.

Table 6: Goal Sets for Treatment of the NICoE patients [26]

Goal Set 1	Goal Set 2	Goal Set 3
Ensure safety	Intensive/integrative diagnoses	Enhance self-management/self-efficacy
Improve sleep	Decrease polypharmacy	Improve relationships (family, chain of command, peers)
Decrease physical pain	Self-awareness: patient- and family-centric approach to understand problems preventing recovery	Improve functional cognitive performance
Decrease psychological pain	Establish goals for recovery	Improve psychosocial functioning
Decrease moral/ethical pain		Improve physical performance
Facilitate positive use of the health care system/restore trust in the system		

To achieve these goals the NICoE provides a wide array of evaluation and treatment activities that encompass western medicine, complementary approaches, and alternative therapies. The typical activities and additional interventions that are employed at the NICoE are found below [26].

The NICoE Activities

- Nursing
- Internal medicine/Family medicine
- Neurology (including Electroencephalography (EEG) as needed)
- Sleep Neurology (including Actigraphy, Polysomnography (PSG))
- Psychiatry
- Licensed Specialist Clinical Social Worker (LCSW): Family therapist
- Art Therapy
- Spirituality
- Physical Therapy including NeuroCom, Computer Assisted Rehabilitation Environment (CAREN)
- Neuropsychology
- Occupational Therapy including Visual Perceptual Evaluation, Assistive Technologies
- Speech Language Pathology
- Optometry
- Audiology/Vestibular Evaluation
- Nutrition
- Radiology (MRI, PET [Position Emission tomography]/CT [Computed Tomography] of the brain)
- Other consultations as needed

Other Interventions

- BOTOX
- Nerve Blocks, Trigger point injections
- Acupuncture
- Biofeedback
- Heart Math
- Autogenic Training
- Frequency Specific Microcurrent
- Comprehensive Soldier Fitness-PREP
- Mind-Body Skill building
- Group therapy
- Education course
- Journaling
- Bibliotherapy
- Positive psychology
- Neurofeedback
- Recreation therapy
- Animal Assisted Therapy
- Music, Laughter and Humor

These provide an indication of the scope of services that are employed for provision of the finest in interdisciplinary care for service members with TBI and PH conditions. For a listing of therapies that are considered to be Complementary and Alternative Medicine (CAM) and treatments see Appendix B and Education and Wellness Courses are found in Appendix C.

The research prong of the NICoE's mission is aligned with the clinical services that are provided to service members. The DOD population provides a distinctive population base and "the most current technical and clinical resources for initiating innovative pilot studies to advance the characterization of the pathophysiology of the co-morbid state, while additionally serving as a "hub" for exchanging information with federal and academic partners [26]. Examples of research protocols are found in Chapter Two and the advanced technology that the NICoE employs in clinical care will be discussed in the following section. According to the National Intrepid Center of Excellence [1], patients can participate in the pilot studies or research protocols, which are approved by the Institutional Review Board (IRB), on a voluntary basis. Service members' acceptance status in terms of research options offered has no impact on the evaluation and treatment that they receive at the NICOE. A dedicated research team, concerned with comorbid TBI and PH, conducts the research for application to the clinical care setting and are part of the NICOE stakeholder network. The team partners with military, federal, and academic colleagues, which are also a part of the network in an external sense and are indicative of the NICOE's ecosystem.

3.2.1.4 IT/Infrastructure View

With respect to the NICoE, the IT/Infrastructure view consists of the NICoE facility, its satellites, as well as the Fisher Houses. This view also consists of the comprehensive and state-of-the-art technology that is used at the NICoE for evaluation, treatment and research purposes. The NICoE, located on the Bethesda, MD campus that includes the WRNMMC, is a 72,000 square foot facility that was built and equipped using $65 million in private donations secured by the IFHF who also supervised its construction [1]. Presently, plans include a total of nine satellite locations, with funding provided through the efforts of the IFHF [6]. The nine satellites include Camp Lejeune (Camp Lejeune, NC), Camp Pendleton (Camp Pendleton CA), Fort Belvoir (Fort Belvoir, VA), Fort Bliss (Fort Bliss, TX), Fort Bragg (Fort Bragg, NC), Fort Campbell (Fort Campbell, KY), Fort Carson (Fort Carson, CO), Fort Hood (Fort Hood, TX), and Joint Base Lewis-McChord (Joint Base Lewis-McChord, WA) [7]. The locations of the NICoE and its satellite centers are shown in Figure 8.

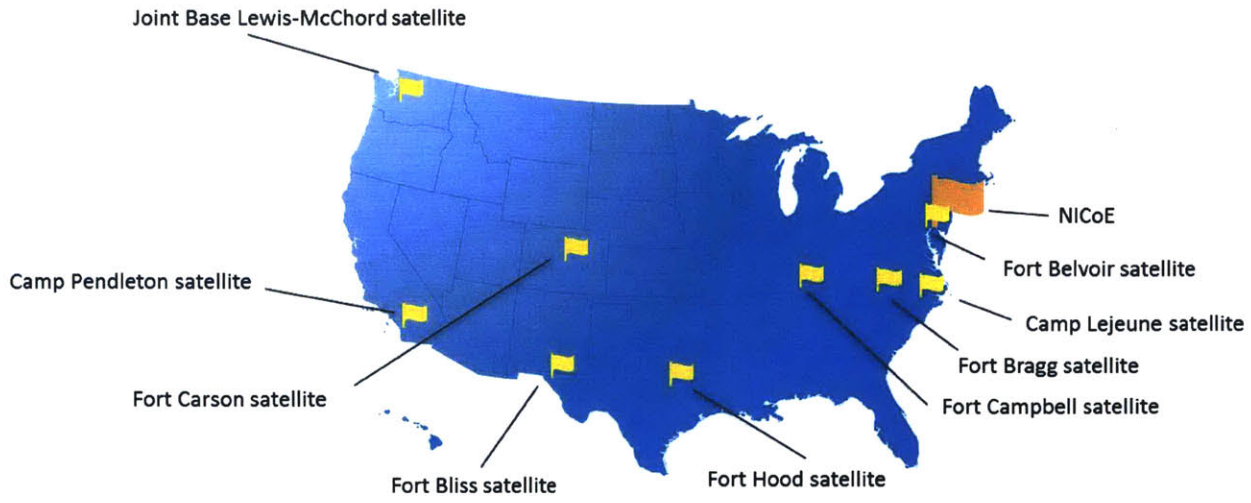


Figure 8: The NICoE and its Satellite Center Locations

Presently, the satellites have already been built, are under construction, or slated to be built. Camp Lejeune and Fort Belvoir have already been built [1]. Fort Bragg and Fort Campbell broke ground and January 24, 2014 and on June 13, 2013, respectively [6]. Each satellite is or will be about 25,000 square feet and cost $11 million to build and equip with the latest technology [6].

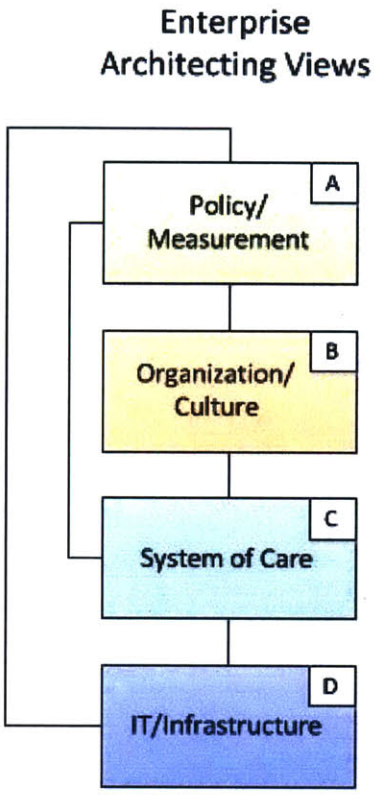
The NICOE has advanced equipment for diagnostic and rehabilitation purposes, with the major types of equipment as follows [11]:

- Magnetic Resonance Imaging (3-T) / Functional MRI / Diffusion Tensor Imaging
- Positron Emission Tomography with Computed Tomography (PET/CT)
- Magneto encephalography (MEG)
- Scanner
- Trans-Cranial Doppler Ultrasound
- Fluoroscopy
- CAREN (Computer Assisted Rehabilitation Environment) system

Only seven CARENs exist worldwide; it is a "system housed in its own room that allows virtual reality to be incorporated into the assessment and rehabilitation of injured service members. The virtual reality areas' capabilities include a sensory room and a physiological room, as well as a fire arms training simulator (FATS) room, used to recreate simulations in over 200 combat scenarios. A driving simulator will be used to detect cognitive, visual and motor skill impairments and will assist in maintaining individual independence and mobility" [61]. This type of technology helps to ensure that service members are provided an optimal means for evaluation and treatment of TBI and PTSD.

3.2.1.5 Interrelationships between EA views

Illustrations of the interrelationships between the EA views are found in Figure 9, with each view having an associated letter (A, B, C, or D) that denotes the connections between the views (e.g., A-B, A-C, etc.).



Enterprise Architecting Views

A-B	Knowledge sharing for impacting quality of care
A-C	Measures for clinical care
A-D	Measures for facility design
B-C	Knowledge sharing for service members and family
C-D	Facilities and advanced technology for influencing clinical care

Figure 9: Interrelationships between Enterprise Architecting Views

The Policy/Measurement view concerns all of the other views. This view's discussion of quality of care can be influenced by knowledge sharing, mentioned in the Organization/Culture view, and its measurements relate to both clinical care in the System of Care view and the NICoE facility in the IT/Infrastructure view. In addition, knowledge sharing found in the Organization/Culture view relates to information provided to service members and their families in the System of Care view. Finally, the NICoE and advanced technology in the IT/infrastructure view relate to clinical care in the System of Care view.

3.2.2 Sustainability Pillars and their Interrelationships

3.2.2.1 Social Sustainability Pillar

Before discussing how the NICoE relates to the social Sustainability Pillar, it is important to clarify how it is distinguished from the culture Sustainability Pillar. As stated previously in Chapter Two, the social Sustainability Pillar is concerned with social justice and human rights, whereas the culture pillar focuses on individuals in terms of their respective values, identity, and the social or community structure in which they live. Thus the social Sustainability Pillar has more of a focus on society as a whole as opposed to the culture pillar, which is concerned with the individual person and direct environment in which they live.

Along this vein, the social Sustainability Pillar relates to the Research prong of the NICoE's mission statement. The NICoE engages in pioneering research efforts to advance the understanding of the comorbid state of TBI and PH using state-of-the-art technology and equipment while serving as a hub for collaboration with federal, academic, and industry colleagues [60]. These research efforts and partnerships, which were discussed previously in this Chapter as well as in Chapter 2, serve to benefit society in terms of furthering an understanding of these comorbid conditions.

3.2.2.2 Culture Sustainability Pillar

With respect to the NICoE, the culture Sustainability Pillar relates to the well-being of individuals with respect to their surrounding communities—that which affords an individual and their surroundings to thrive and prosper in a sustainable fashion—and concerns the Clinical Care and Education prongs of the NICoE's mission. It also includes a respect for diversity in terms of the individual differences of people and their communities that relates to the NICOE's patients, their family members, and the healthcare milieu in which they function.

Kelly and DeGraba [11] characterize the NICOE as an "optimal healing environment" with a "spirit of hospitality," one that offers "interdisciplinary, integrative, holistic, and family-based care." Table 7 provides information by the authors on patient intake factors, the NICoE goals, and the trajectory of recovery, which are reflective of the transformative nature of the NICoE's approach.

Table 7: The NICoE's Patient Intake Factors, Goals, and Trajectory of Recovery [11]

Patient Intake Factors	The NICoE Goals	Trajectory of Recovery
Poor military performance	Reduce impairment	Enhanced and motivated
Fractured interpersonal relations	Reduce disability	Performance
Reliance on substances	Reduce suffering	Recovery interpersonal
Physical and mental pain	Provide tools to manage symptoms	Use of mind/body skills
Lack of empowerment	Instill hope	Reduction in pain
		Self management

A case in point of the NICOE's "model of hospitality" lies within the building itself. Foote and Schwartz [53] describe the "wellness" aspects of its design. There are designated areas for recreation, athletic endeavors, and art and music therapy, as well as for contemplation (a chapel and garden areas). A 50 foot in diameter area called Central Park, with a labyrinth, glass roof, and plantings, is also used for reflection purposes, as well as art-related exercises and performances. Further, the flow between the more technically-centric and other areas is seamless in nature, "symbolizing the unity of the healing disciplines." Hospitality is also evident in the accommodations provided by the Fisher House Foundation.

A respect for diversity is manifested both through the NICoE's patient– and family–centric emphasis, as well as how it relates to the MHS. In recognition that patients have distinctive needs Sargent et al. [62] note that patients have customized treatment planning and evaluations that involve the family. The authors explain that patient choice is included in some

of the treatment options with the recognition that it will foster collaborative exchange with those delivering care, as well as facilitate a cooperative patient mindset. Further upon discharge, the NICOE equips the patient's service provider with information and follow-up to afford continuance of the care. In this way, the NICOE is impacting care in the MHS at large without disruption to the inherent diversity that lies therein as gleaned from an interview with the NICOE personnel.

Along the same lines, the Education faction of the NICoE's mission is another way in which the NICoE has impact through its training and education seminars, including the ECHO program as discussed previously. Education can also help with the stigma associated with getting help. Dr. James Kelly in a published interview mentioned that a distinctive place like the NICoE, with its specialized evaluation and treatment aspects, will help in dissolving this stigma in support of other education in the DOD that is being offered in this regard [12].

3.2.2.3 Environmental Sustainability Pillar

With respect to the NICOE, the environmental Sustainability Pillar relates to Leadership in Energy and Environmental Design (LEED) certification of its facility and represents an aspect of its ecosystem. The U.S. Green Building Council [63] or the UGBC awards LEED certification through a third-party rating system in relation to "green" building design. The LEED certification levels are as follows:

- LEED Certified: 40 through 49 points
- LEED Silver: 50 through 59 points
- LEED Gold: 60 through 79 points
- LEED Platinum: 80+ points

The NICoE was awarded LEED Silver certification. The breakdown of the LEED categories and the NICoE's corresponding scores are found in Table 9.

Table 8: LEED Categories and the NICoE Scores [63]

LEED Categories	The NICoE Score / Possible Score
Sustainable sites	9 / 14
Water efficiency	4 / 05
Energy and atmosphere	4 / 17
Material and resources	6 / 13
Indoor environmental quality	9 / 15
Innovation	5 / 05
Total Score	**37 / 69**

3.2.2.4 Economic Sustainability Pillar

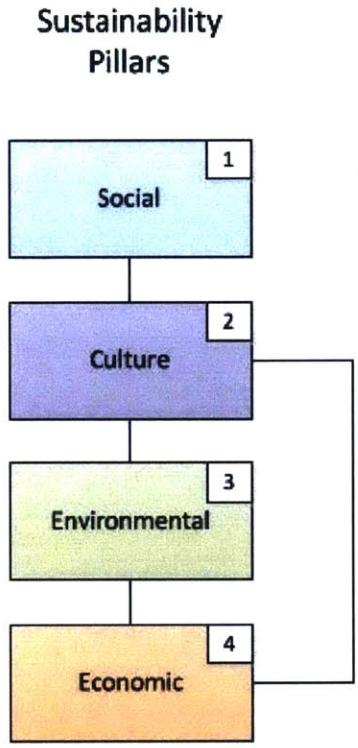
In general, the economic sustainability pillar in relation to the NICoE corresponds to the building, equipment, staffing, technology, maintenance, and other costs associated with providing cutting-edge care to patients and their families, as well as conducting research and education.

Information that is readily available in terms of economic factors related to the NICoE is that which was funded by the IFHF to construct and equip its 72,000 square foot the NICoE facility, totaling $65 million in private donations, which also included the supervision of the construction process [1]. The service members and their families are also provided with accommodations during their stay at the NICoE at a Fisher House, reserved just for their purposes [1], which is funded by the Fisher House Foundation [64]. In this sense, IFHF, Fisher House Foundation, and their private investors are critical stakeholders in terms of the NICOE's very existence.

Dao [54] reported that the NICOE's network that includes the satellite centers, "the largest privately funded construction project ever done for the Pentagon, which often resists assistance from outside groups." Additionally the author mentioned that the military is responsible for staffing and running the facilities in the network.

3.2.2.5 Interrelationships between Sustainability Pillars

Instances of the interrelationships between the Sustainability pillars are found in Figure 10.



Sustainability Pillars

1-2	Research for impacting clinical care; stigma for getting help in military and society in general
2-3	LEED design for impacting clinical care
2-4	IFHF and Fisher House Foundation and patient-centered care for influencing costs
3-4	LEED design for impacting cost

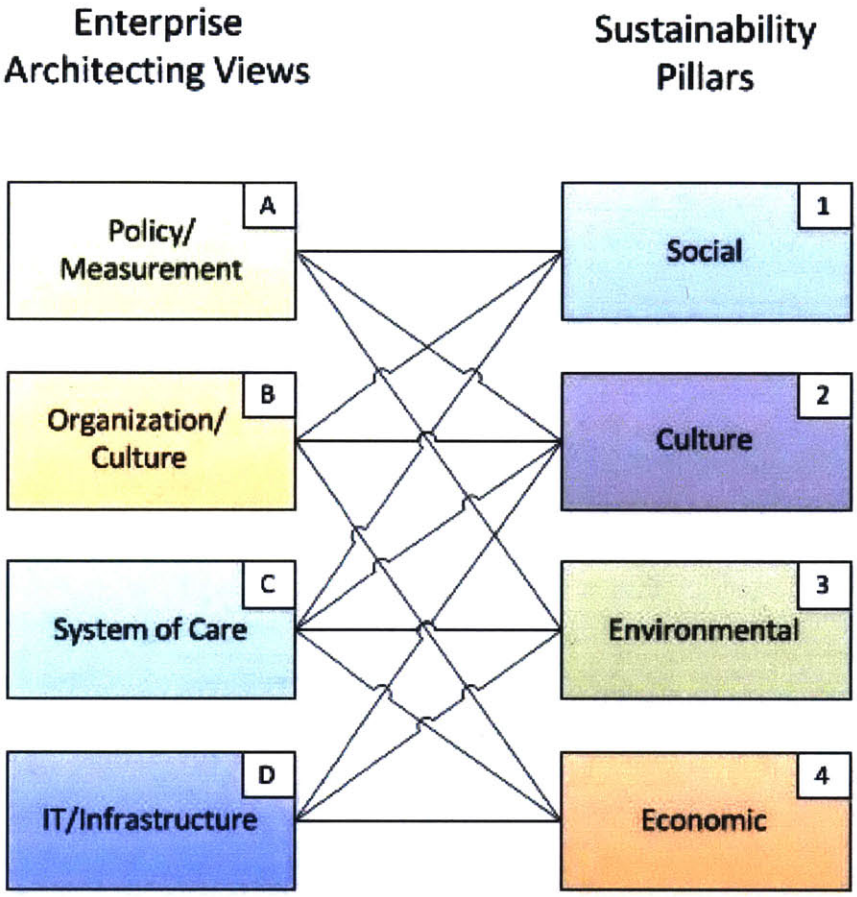
Figure 10: Interrelationships between Sustainability Pillars

The Social pillar's research focus can impact clinical care in the culture pillar, and the culture pillar's stigma for getting help in the military can also apply to society in general, which relates to the social pillar. In addition, the culture pillar applies to the Environmental pillar and the Economic pillar. The clinical care in the culture pillar relates to the LEED aspects of design in the Environmental pillar. The use of the NICoE facility and Fisher House in the clinical care of the Culture pillar relates to reduction in costs in the Economic pillar. Likewise, patient-centered

care in the former can result in reduction in costs in the later [65]. Finally, the LEED design of the facility in the Environmental pillar leads to reduced costs on the economic pillar.

3.2.3 Interrelationships between EA Views and Sustainability Pillars

Illustrations of the interrelationships between the EA views and the Sustainability Pillars are found in Figure 11.



Enterprise Architecting Views and Sustainability Pillars

A-1	Research for impacting quality of care
A-2	Measures for facility design
A-3	Measures relating to LEED certification
B-1	Knowledge sharing for outreach
B-2	Diversity in organizational structure and clinical care
B-4	Costs for education
C-1	Research for impacting society
C-2	Clinical care for impacting stigma and related to customized care
C-3	LEED design for impacting clinical care
C-4	Costs for clinical care and research
D-2	Facility design for influencing stigma and clinical care
D-3	Facility design and LEED
D-4	IFHF and Fisher House Foundation for influencing costs

Figure 11: Interrelationships between Enterprise Architecting Views and Sustainability Pillars

There are three connections for the Policy/Measurement view. Research in the social pillar can impact quality of care in the Policy/Measurement view. Measurements in the Policy/Measurement view relate to the NICoE facility in the culture pillar and aspects of LEED certification in the environmental pillar.

Three linkages pertain to the Organization/Culture view. Its knowledge sharing is linked to research and outreach in the social pillar, as well as to costs (minus IFHF and Fisher House Foundation funding) in the economic pillar. In addition, its diversity, manifested in its organizational structure of the WRNMMC, is linked to diversity in clinical care within the culture pillar.

The System of Care view has four connections: its research relates to impacting society in the social pillar; its clinical care to the stigma associated with getting help and customized care in the culture pillar, as well as the LEED aspects of design in the environmental pillar; and, it costs to research and clinical care (minus IFHF and Fisher House Foundation funding) in the economic pillar.

Finally, there are three connections for the IT/Infrastructure view. In relation to the NICoE facility in this view, the stigma associated with getting help and clinical care in the culture pillar, as well as LEED certification in the environmental pillar. The facility also relates to IFHF and Fisher House Foundation in the economic pillar.

Chapter 4 involved an investigation and characterization of the NICoE relative to the EA views and Sustainability Pillars frameworks. This included a depiction of the interrelationships between the EA views, as well as the Sustainability Pillars. Further, it involved an examination of the interrelationships between the EA view and the Sustainability Pillars. In Chapter 5, information found on NICoE satellite centers will be provided, which includes a brief spotlight on Fort Belvoir. In addition, in lieu of the development and implementation of NICoE network

that is underway, heuristics will provided relative to the replication and adaptation of NICoE to its satellite centers.

Chapter 4

The NICoE Replication to Satellite Centers and Heuristics for Implementation

In alignment with the NICoE's five-year strategic plan, the NICoE's imperatives include quality evaluation and treatment of the comorbid TBI and PH conditions through state-of-the art research, as well as influencing the quality of health care in the MHS, with a three-prong mission involving clinical care, research, and education [1]. The replication of the NICoE to satellite centers constitutes an avenue for advancing the NICoE's mission and realizing these objectives. Presently, there are nine satellites centers that have already been built, are under construction, or are slated to be built at the following military bases: Camp Lejeune in NC, Camp Pendleton in CA, Fort Belvoir in VA, Fort Bliss in TX, Fort Bragg in NC, Fort Campbell in KY, Fort Carson in CO, Fort Hood in TX, and Joint Base Lewis-McChord in WA [1, 6, 7]. Each of these centers will accommodate about 1000 patients per year, as opposed to the NICoE which handles 250 [54]. In this chapter, the information that pertains to all of the satellites will be presented while briefly highlighting the Fort Belvoir center in order to characterize a specific site.

The IFHF, who have already or will be funding the construction of the satellite centers at roughly $11 million each through their efforts and generosity, provide the following information on the nature and objectives of these centers [6]. In terms of services offered, the state-of-the-art clinical care prong of the NICoE's mission will be the emphasis of the satellites. In addition, the satellites will provide information on their clinical work to the NICoE and hence be a contributory factor in its research efforts to further understand the comorbid TBI and PH

conditions, for which the IFHF also provides financial support. Financial support is also supplied in terms of housing at each satellite for families through the Fisher House Foundation, a sister organization of the IFHF. Relative to the NICoE as a 72,000 square foot facility [1], the satellite facilities are or will be about 25,000 square feet. The types of spaces within each satellite are found below:

- Intake/Clinic area: includes psychiatric testing, chiropractic treatment, acupuncture, neuro psych testing rooms, and typical exam rooms
- Physical Therapy: open gym layout with standard physical therapy equipment including adjustable mat tables, parallel bars, treadmills, alter-G gait trainer, and other physical therapy items
- Sleep Lab: one sleep room, equipped with the sleep system and ambient therapy music; and a control room, equipped with a computer monitoring system
- Central Park: Similar to the Central Park space at the NICoE, providing a calm atmosphere for patient and family member relaxation and family education, with a meditative feel and including ambient therapy music
- Family Room: centrally located and adjacent to the outdoor patio, providing a reprieve space for patients and family to spend time together and take a break from the clinical treatment regime

Fort Belvoir was the first satellite that was opened at Fort Belvoir Community Hospital on September 11, 2013 [1], with Heechin Chae, MD, as the Director [66]. The center was registered for LEED certification on July 18, 2012, which is in progress [63]. The Fort Belvoir Community Hospital [67] describes an art therapy pilot program for provision to patients at the satellite center, referred to as Fort Belvoir's Intrepid Pavilion, as the result of a partnership between the DOD and NEA. A creative arts therapist will deliver the program on an individual or group basis, which will involve visual arts, mask-making, and therapeutic writing "to help patients communicate, externalize, and process traumatic events, as well as improve and restore neurological and physical function." Depending on the success of the three-month pilot

program, there is potential for the program being implemented for a longer duration at the other satellite centers.

4.1 Heuristics

The objective of the following heuristics, defined in this case as "relating to general strategies or methods for solving problems" [68], to provide guidance for the replication and adaptation of the NICoE to its satellite centers. They were primarily based on the analysis of the NICoE using the EA views and Sustainability Pillars, information found on the satellite centers, and research that was provided in Chapter 2 on replication and adaptation.

4.1.1 Heuristic One: Living Process Document

Relevant to the literature on replication concerning NICoE, a rigorous and dynamic codification of processes that must be performed in a procedural and uniform fashion across the satellite centers will reduce ambiguity, ensure consistency across satellites, and serve as a source of reference for clarification when issues arise. This is particularly important in situations where a procedure or best practice may have more than one interpretation, in which lack of adherence would compromise the quality of care provided to service members relative to that provided by the NICoE.

The process document should be active in nature for the accommodation of updates when evidence exists that a modification would result in better outcome measures; there are issues causing unwarranted redundancy, inefficiency, or ineffectiveness; there are new or updated DOD or other mandates requiring changes; or when improved health care practices necessitate modifications. One example of a process involves patient referral by a service provider and acceptance or denial involving further referral as mentioned Chapter 3. Another is the protocol involved in the participation of service members from any given satellite in research at the NICoE. For each documented process, there should be an avenue for input from each satellite to voice the need for exceptions due to lack of fit with their environment, which should be duly

noted in the document if clearly demonstrated. Periodic reviews should be scheduled in advance with input from all stakeholders involved or when otherwise appropriate.

4.1.2 Heuristic Two: Principle-driven Replication

In addition to the aforementioned heuristic, this heuristic is reflective of the research on replication as it pertains to NICoE. A delineation of the principles that reflect the underlying mission of the NICoE in terms of the cutting-edge diagnosis and treatment of the comorbid TBI and PTSD condition will both reinforce its practice at the satellite centers, as well as foster attentiveness to the particular needs of the care delivery at hand. In addition to the principles, it is important to supply supporting artifacts in order to provide a contextual foundation for implementation.

The artifacts should include a detailed, satellite-specific rendering of the NICoE's mission, strategy, objectives, and other related factors. The goal is to provide an understanding of the purpose and role of the NICoE's and its satellites as entities, as well as how they should perform as a network with interrelationships. This is similar in nature to that which was depicted in the interconnections between the EA views and Sustainability Pillars in Chapter 3. In addition, the artifacts should include information on communication channels, protocol for interaction with staff and patients, use of nomenclature for the sake of consistency, and conveyance of innovative practices that includes input from care givers. Finally the artifacts should provide avenues for securing education and training in the areas of expertise of the staff, as well as other information that will facilitate the delivery of quality care. Like the aforementioned process document, the principles and artifacts should include updating on a periodic basis with a means for stakeholder input.

4.1.3 Heuristic Three: Governance and Associated Measurements

The implementation of governance and associated measurements, relative to the Policy/Measurement EA view, to ensure compliance to the directives that the NICoE has set

forth for the satellites will reinforce adherence to procedures and principles as identified in the replication literature, provide a means to gauge the efficacy of the directives for further investigation and modifications if necessary, and justify interventions when needed, as identified. This will serve as an accountability mechanism for both the NICoE in terms of its oversight of the satellites, as well as the satellites with respect to compliance. With respect to procedures that involve codification, the literature also mentions the need for success measures.

Measures should be instituted that extend beyond those related to the evidenced-based measurements that are used to access the efficacy of and service member satisfaction pertaining to clinical care. These should include measures that target compliance-related adherence to the NICoE directives on the part of the satellites. Avenues for the satellites to report on satisfaction with the NICoE's oversight function and offer feedback should also be established. An analysis of the measures should include a means to uncover any root cause issues of non-compliance. Finally, a review should be scheduled after metric collection to identify successes for the provision of accolades and making further inroads, as well opportunities for improvement.

4.1.4 Heuristic Four: Supporting Infrastructure

This heuristic is primarily concerned with IT/Infrastructure EA view of and serves as a foundation for instituting replication as described in the literature. The establishment or scaling of an existing infrastructure for the activities of the aforementioned heuristics in terms of technology, equipment, and staffing will be necessary to facilitate their successful implementation and maintenance. The infrastructure should also be scalable to incorporate technological advances and additions to the NICoE network concerning satellite centers, patient caseloads, and research-related activities in support of the NICoE's mission.

The technology should foster the use of virtual communication and hence interconnectivity between the NICoE and its satellite centers, through capabilities that are innovative in nature,

user-friendly, and reliable. An example includes virtual interaction between the satellites involving the potential rollout of the art therapy program at Fort Belvoir that was previously mentioned. In addition, the necessary data center support, machines, equipment, and software for the enhancement of productivity and efficiency should be provided, as well as associated administrative support. Staffing should be added as appropriate for overseeing and implementation functions.

4.1.5 Heuristic Five: Internal and External Impacts

A continuance and further utilization of practices and initiatives in facilitating the NICoE's three-prong mission, with application of its pertinent aspects to the satellite centers, will provide a supporting foundation to influence the widespread delivery of quality health care. This includes making impacts involving the MHS and society in general in terms of the comorbid TBI and PH conditions.

As the satellite centers are being launched at the different geographic locations and service branches, the practice of influencing the quality of care through the referring service provider will continue to be imperative, as well as educational outreach. A respect for diversity will further involve adaptation to the culture of the individual center, an important factor as shown in the replication literature that relates to adaptation, while concurrently instituting the practices that ensure the delivery of state-of-the-art clinical care. Additional opportunities in terms of impacting the quality of care should be explored through targeting areas that are ripe for making inroads. With respect to external factors, the use of private funding, such as that provided through the generosity of the IFHF and Fisher House Foundation, should be leveraged as appropriate for the expansion of the NICoE network and delivery of quality health care. Finally, the NICoE partnerships with institutions and organizations involved in advancing the comorbid and PH conditions should continue to flourish and have relevance for the satellite centers.

Chapter 5

Avenues for Future Research

The NICoE has a cutting-edge emphasis in its three prong mission involving clinical care, research, and education. As stated by the NICoE Patient Welcome Guide [69], a synopsis of how the NICoE is distinctive relative to other TBI / PH programs offered by the DOD MTFs is found below:

> The NICoE utilizes an interdisciplinary approach to care, featuring a comprehensive team of medical professionals offering intensive diagnosis and treatment planning. Because of our unique clinical care model, providers are able to focus on both service members and their families. The NICoE is also home to the latest medical technology, allowing immediate access technology required to diagnose and assess TBI and PH conditions. Serving as the a hub of public-private network of military and civilian local, regional, state, federal and global resources, the NICoE develops treatment plans, clinician and service member education programs, long-term follow-up and continuity management in one central location.

This provides a unique opportunity for understanding NICoE as an enterprise, as well as how its clinical prong is replicated for further impact to the MHS.

This thesis provided an investigation of the NICoE from an engineering systems perspective using the EA views and the Sustainability Pillars. In order to recommend guidance for the replication of the NICoE to its satellite centers, this thesis also included the generation of a set

of heuristics that emerged from the pertinent aspects of this investigation and replication-related research.

The following recommendations reflect the limitations of the study in some cases, and the opportunities for future research.

1. **Validate findings and heuristics through interviews with the NICoE stakeholders**
   Since this study was principally based on publically-available information, further study could involve the validation and expansion of the information found through interviews with the NICoE stakeholders. This relates to the EA view and the Sustainability Pillars. In addition, the relevancy of the heuristics could be validated through this means since these were generated as the result of the information in the study.

2. **Examine the NICOE network's relationship with the rest of the MHS**
   The scope of this study involved the NICoE and its satellite centers. Broadening this scope to entities outside of the boundary encasing NICoE and its satellites could illuminate the interfaces between the NICOE network and other internal organizational entities, particularly in relation to patient care. This is especially relevant for the satellites centers, which are housed on some of the military home bases.

3. **Conduct modeling to determine the NICoE's impact on the quality of care**
   One of the NICoE's objectives is to influence the quality of care that is delivered in the MHS. Additional study involving modeling could help to determine the long-term results of the care that a patient receives at the NICoE and the satellites, how the collaboration and follow-up with the patient's service provider affects treatment outcomes in general, and how the educational prong of the NICoE affects the quality of care.

4. **Determine the economic ramifications of the NICoE and its networks**

   This concerns the cost of the program and any related effects on other programs for the diagnosis and treatment of service members in terms of TBI and PH, particularly PTSD. It also relates to cost savings as the result of the cutting-edge care that patients at the NICOE receive. A cost-benefit analysis and related measures could be used.

5. **Examine how external funding can be used to facilitate the quality of care in the MHS**

   The construction of the NICoE and its satellites was funded through the IFHF, and the Fisher Houses, where the family members stay at no cost, was funded through the Fisher House Foundation. Further study could involve how non-profit sources could be utilized to advance quality health care in the DOD.

6. **Investigate how the NICOE can be leveraged for the MHS transformation**

   The NICoE is in a unique position to influence the quality of care by way of its DOD-wide services that it provides, its reporting structure to the WRNMMC and ultimately the DHA, and network, which resides on the home bases of different service branches in various locations. In addition, the NICoE offers the quality of care that the transformation seeks to achieve. Further study concerning the NICoE as an enterprise in these respects could shed light on transformational practices.

Appendix A

List of Acronyms and Meanings

APA	American Psychiatric Association
ASD (HA)	Assistant Secretary of Defense (Health Affairs) ASD (HA)
CAM	Complementary and Alternative Medicine
CAREN	Computer Assisted Rehabilitation Environment
DHA	Defense Health Agency
DHI	Dizziness Handicap Inventory
DHS	Defense Health Agency
DOD	Department of Defense
EA	Enterprise Architecting
ECHO	Extension for Community Healthcare Outcomes
EEG	Electroencephalography
fMRI	Functional Magnetic Resource Imaging
GCS	Glasgow Coma Scale
HIT	Headache Impact Test
ICT	Institute for Creative Technologies
IFHF	Intrepid Fallen Heroes Fund
IRB	Institutional Review Board
LCSW	Licensed Specialist Clinical Social Worker
LEED	Leadership in Energy and Environmental Design
MEG	Magnetoencephalography
MHS	Military Health System
MPHE	Military Psychological Health Enterprise
MRI	Magnetic Resource Imaging
mTBI	Mild TBI
MTF	Military Treatment Facility
NASHIA	National Association of State Head Injury Administrators
NEA	National Endowment for the Arts
NICoE	National Intrepid Center of Excellence
NRC	National Capital Region
NSI	Neurobehavioral Symptom Inventory
PCL-M	PTSD Check List-Military
PH	Psychological Health

PSG	Polysomnography
PTSD	Post Traumatic Stress Disorder
RWTF	Recovering Warrior Task Force
SWLS	Satisfaction with Life Scale
TBI	Traumatic Brain Injury
UN	United Nations
USC	University of Southern California
USD (P&R)	Under Secretary of Defense (Personnel and Readiness)
USGB	U.S. Green Building Council
USU	Uniformed Service University of Health Sciences
ViRTICo-DP	Virtual Reality Therapy and Imaging in Combat Veterans with Blast Injury and PTSD
WRNMMC	Walter Reed National Military Medical Center

Appendix B

Complementary and Alternative Medicine (CAM) Therapies and Treatments

The CAM therapies and treatments listed below are found in the NICoE Patient Welcome Guide [69] and offered to service members:

- Acupuncture
- Acupressure
- Assistive Technology
- Art Therapy
- Bibliotherapy
- Cranial Electrical Stimulation
- Gua Sha
- Exercise
- Hypnosis
- Journaling
- Meditation
- Microcurrent treatments, as well as trigger point injections, BOTOX and nerve blocks
- Music Therapy
- Physical, Occupational and Speech Therapy
- Reiki/Healing Touch
- Spirituality
- Tai Chi/Qigong
- Yoga

Appendix C

Education and Wellness Courses

The following information on education and wellness options provided to service members is found in the NICoE Patient Welcome Guide [69].

- Coherent Breathing
- Comprehensive Soldier Fitness–Performance and Resilience Enhancement Program (CSF-PREP): This class focuses on six group topic discussions: Foundations; Building Confidence; Goal Setting; Attention Control; Energy Management; Integrating Imagery
- Fire Arms Training Simulation
- HeartMath® course to learn heart rate variability and autonomic control
- Improving Cognitive Performance
- Inner Wisdom
- Introduction to Brain Nutrition
- Introduction to Sleep Disorders
- Introduction to the Service Dog Program
- Introduction to Traumatic Brain Injury
- Introduction to Wellness
- Labyrinth Initiation: This course focuses on mindfulness in movement, initial walking meditation, labyrinths as sacred space of movement and a ritual of new beginnings.
- Occupational Functioning: As part of this course, service members participate in the Occupational Therapy Community Reintegration program, a one-day field trip planned by service members.

- Overview of Cognitive Distortions
- Positive Imagery

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