

Application of the Neurosequential Model of Therapeutics (NMT) in an Integrative Outdoor Behavioral Healthcare Program for Adolescents and Young Adults

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Introduction

The teen brain undergoes substantial developmental changes in stressor-sensitive brain regions when the prefrontal cortex is not yet fully developed (Romeo, 2013; Spear, 2000). Hence, adolescents tend to be emotionally-driven with highly reactive stress response systems. Although most young people successfully navigate this stormy phase of development, those who enter adolescence with challenges such as anxiety, depression or trauma as well as those who experience certain stressors may be particularly vulnerable to acquiring serious and longstanding mental health problems and addictions (Grant et al., 2006; Romeo, 2013). One in four adolescents experience mental disorders that result in severe impairment, and half of those will go without mental health services (Lipari, et al., 2016). Thus, millions of adolescents in the US enter young adulthood in distress and are ill-equipped to meet life's demands, highlighting the need for intervention.

The Neurosequential Model of Therapeutics© (NMT) is an evidence-based, developmentally-sensitive approach to clinical problem solving that is informed by the principles of neurodevelopment (Perry, 2006; Perry, 2016). NMT is not a specific therapeutic technique, but rather a lens that helps to identify individual strengths and vulnerabilities and to select and sequence appropriate activities and interventions (Perry, 2016). Although NMT emerged to meet the complex needs of maltreated and traumatized children (Perry, 2009), NMT is applicable to a variety of therapeutic settings across the full life cycle (Perry, 2016).

In the best-selling book, *Your Brain on Nature*, Selhub and Logan (2012) present a scientific explanation for the “2 million-year relationship with the natural environment that has been imprinted on our neurons” (p.1). Empirical studies confirm a wide range

of health benefits of nature with data suggesting that purposeful engagement with nature has the power to improve neurochemical function, decreasing stress and emotional dysregulation (Barton & Pretty, 2010; Berto, 2014; Stigsdotter et al., 2010). Despite the growing body of research supporting the relationship between the brain and nature, the application of a neurodevelopmental approach such as NMT in nature-assisted therapy has yet to be fully explored.

This article explores the application of NMT at Pacific Quest (PQ), an integrative outdoor behavioral healthcare program that uses horticultural therapy and other experiential modalities to treat adolescents and young adults with a variety of emotional and behavioral problems. In this nature-assisted approach to whole person wellness, the neurosequential model provides an empirical basis for therapeutic garden design, clinical interventions, and program structure.

First, key terms are defined. Next, an overview of PQ's integrative clinical practice model is provided. Lastly, applications of NMT are presented with a particular focus on the horticultural component of the program, including the therapeutic gardens.

Outdoor Behavioral Healthcare (OBH)

Outdoor behavioral healthcare (OBH) describes a range of specialized therapeutic programs for youth where group living, immersion in nature, and various clinical, experiential and psychoeducational interventions are used to interrupt and assess maladaptive behavior and to promote emotional growth and personal and social responsibility (Russell & Hendee, 2000; Russell, 2001). OBH is found to be effective with adolescents and young adults with an array of severe emotional or behavioral problems and a history of trauma and/or substance abuse (Bowen & Neil, 2013; Roberts, Stroud, Hoag, & Combs, 2016;

Russell, Gillis, & Lewis, 2008). Historically, the term OBH has been synonymous with wilderness and adventure therapy. However, other forms of nature-assisted therapy such as equine and horticultural therapy have emerged as alternatives to traditional hiking and survival-based programs.

Horticultural Therapy

According to Siegel (2006), “nature needs nurture”, and for the nature-assisted therapist specializing in horticultural therapy, the act of nurturing nature is made tangible through the cultivation of plants, providing growth-focused treatment activities that foster a reciprocal relationship with the natural environment (Simson & Straus, 2005). Horticultural therapy (HT) is defined as a client-centered treatment modality utilizing plant-person interaction to meet specific therapeutic goals (Haller & Kramer, 2006). Critical to the application of horticultural therapy is an innate psychological attraction to the interconnectedness of life and the neurobiological drive to care for it (Wilson, 1984). Research indicates an array of health benefits of horticultural activity including improved neurocognitive function, the reduction of stress, and increased life satisfaction across the lifespan (Annerstedt & Wahrborg, 2011; Detweiler et al., 2015; Lee, 2010). Utilizing an innovative approach to horticultural therapy with the neurosequential model as a guiding framework, PQ was recently awarded national recognition for therapeutic garden design by the American Horticultural Therapy Association.

Integrative Health

Integrative health is a research-driven model for whole person wellness that emphasizes the integration of complementary and alternative approaches to healing with conventional medicine (AIHM, 2014). Recognizing the equal importance of mind, body, and spirit and the relationship between practitioner and patient, integrative health has successfully treated common conditions including, but not limited to chronic pain, depression and anxiety, gastrointestinal disorders, cancer and stress (AIHM, 2014).

Pacific Quest Model

Target Population

As an integrative outdoor behavioral healthcare program with a length of stay of 8 to 12 weeks, PQ serves male, female, and gender fluid adolescents (ages 14-17) and young adults (ages 18-24) with a

variety of emotional and behavioral problems such as depression, anxiety, trauma, addictions, health concerns, and co-occurring disorders. These youth are often distressed, dysregulated and overwhelmed by the demands of everyday life. They tend to shut out people who care about them and turn to alcohol, drugs, food, self-destructive behavior, or a screen for fast relief from their emotional pain, often leaving them isolated and arrested in development.

Integrative Clinical Practice

PQ uses an integrative clinical practice model to achieve Sustainable Growth™. Sustainable Growth involves creating lasting and meaningful change: the capacity to continuously adapt to challenges and the recognition that sustaining oneself depends on sustaining one’s environment. A multi-disciplinary team led by the primary therapist is utilized to weave together the five specialized treatment components of the PQ model: health and wellness, horticultural therapy, experiential education, rites of passage, and evidenced-based practice. Table 1 describes these five treatment components.

NMT and Program Design

Perry (2016) notes, “NMT is grounded in the awareness of the sequential development of the brain; cortical organization and functioning depend on previous healthy organization and functioning of lower neural networks originating in the brainstem and diencephalon” (p. 2). With dysfunctional stress response systems in these primitive brain regions, young people presenting for treatment at PQ are often impulsive and emotionally reactive. At first, they struggle to benefit from traditional talk therapies or insight-oriented methods targeting “higher” cortical networks. Therefore, by following NMT’s sequence of engagement-- “regulate, relate, and reason” (Perry, 2015), treatment begins with activating the senses, bringing increased awareness to the body and calming the nervous system. These interventions take place in gardens designed for reflection, self-care, and individual creativity with the landscape and planting. With improved somatosensory processing and self-regulation, the focus of treatment shifts to relational and cognitive-behavioral interventions in a community garden setting.

Clients move through phases of the program designed to support treatment goals that progressively target one or more of NMT’s four functional domains: sensory integration, self-regulation,

Table 1

Five Treatment Components of the Pacific Quest Model of Integrative Clinical Practice

Health and Wellness	<p>On-site naturopathic physicians, integrative psychiatrists, nurses and wellness coordinators serve as integral members of the treatment team supporting the “5 Pillars of Health” platform (Zimmer, 2012):</p> <ul style="list-style-type: none">• Nutrition: Organic, whole foods, anti-inflammatory diet• Movement: Yoga, Qi Gong, aerobic exercise• Sleep: Restoring circadian rhythm, sleep hygiene• Breathing: Diaphragmatic breathing techniques to calm nervous system• Mind-Body Connection: Such as mindfulness, meditation, body scanning, guided imagery, and other relaxation techniques to enhance the mind’s positive impact on the body
Horticultural Therapy	<p>Client is immersed in a sensory-rich garden setting and placed in an active role of caring for the environment, thereby creating a relational experience with nature that is reciprocal and interdependent. The NMT sequence of engagement-- “regulate, relate, reason” (Perry, 2015) informs this neurodevelopmental approach to horticultural therapy, including garden design and therapeutic activities (Freedle and Slagle, 2014).</p> <ul style="list-style-type: none">• Reflection Garden (Regulate)-Emphasis on sensory integration and self-regulation• Responsibility Garden (Relate)-Building foundations for relational health• Community Garden (Reason)-Emphasis on communication and cognitive problem solving skills
Experiential Education	<p>Utilizing an accredited psychoeducational curriculum delivered in the context of “multiple intelligences” (Gardner, 1999), clients earn high school credit while engaging in hands-on learning in an outdoor environment following Kolb’s experiential learning model (Kolb, 1984):</p> <ul style="list-style-type: none">• Experience• Reflection• Conceptualization• Experimentation
Rites of Passage	<p>Rites of passage (the intentional marking of one phase of life to another) are used to meet crisis and life transitions with a cultural and anthropological perspective. As clients progress through treatment, ritual, ceremony and community celebration provide a strengths-based means to move through the three universal stages of rites of passage (van Gennep, 1960):</p> <ul style="list-style-type: none">• Severance – letting go of the old that no longer serves• Threshold – engaging in a period of reflection, new learning, and new experiences• Incorporation – bringing back what one has learned into their life and community.
Evidence-Based Practices	<p>A team of experienced clinicians bring expertise in a variety of emerging and evidenced-based practices to address individualized treatment needs. The array of therapies include “bottom-up” methods that target movement and neurophysiology, to affective and expressive methods (e.g., art and sandplay therapy), to horticultural therapy, narrative therapy, behavioral therapies, and family systems interventions, to “top down” methods that target mindfulness-based cognitive behavioral therapies.</p> <p>With the client-therapist relationship paramount, NMT provides the over-arching evidenced-based approach informing choice and timing of therapeutic methods.</p>

relational functioning, and cognitive problem solving (Perry, 2006). These functional domains correlate respectively with the neural networks of the brain stem, diencephalon, limbic system, and neocortex. A combination of assessments including behavioral, psychosocial, psychological, integrative health, and psychiatric, along with the NMT “brain mapping” process (Perry, 2009) are used to identify functional level and appropriate intervention. A variety of horticultural therapy activities such as those outlined in Table 2 may be accessed at any time in treatment to address individualized need, promoting neurodevelopment in four domains.

Located on the Big Island, PQ’s treatment setting is further enhanced by the cultural and environmental richness of Hawaii. The program phases have Hawaiian names. A brief overview follows with an emphasis on horticultural applications of the Neurosequential Model.

Nalu is a Hawaiian word that refers to an ocean wave and may be also used to describe the meditative quality of reflection and self-discovery. The nalu phase occurs early in treatment offering an opportunity to pause and reflect on recent life experiences and the natural elements of the serene garden setting. Targeting NMT functional domains of sensory integration and self-regulation mediated by the brainstem, the primary goal of nalu is to soothe the autonomic nervous system. This is accomplished by minimizing stress and emphasizing basic self-care and regulatory activities. Building in patterned, repetitive, rhythmic somatosensory horticultural activities such as walking, digging, weeding, and gathering fragrant flowers and herbs with attentive and responsive program staff promotes a foundation of neurochemical regulation and emotional safety to build on during later stages of treatment.

Table 2

NMT Functional Domain	Brain Region	Horticultural Activities
Sensory Integration	Brainstem	<ul style="list-style-type: none"> • Garden walks • Weeding, watering • Shoveling, digging • Engaging the senses in the garden • Collecting flowers and herbs, aroma therapy
Self-Regulation	Diencephalon	<ul style="list-style-type: none"> • Deep breathing in garden • Clearing, hauling, breaking up rocks • Constructing garden beds • Playing in the dirt • Planting, harvesting
Relational Functioning	Limbic System	<ul style="list-style-type: none"> • Nursery care • Feeding, watering • Transplanting • Cultural sharing- ethnobotany • Earth art, nature crafts, symbolic garden projects • Paired/small group gardening
Cognitive Problem Solving	Neocortex	<ul style="list-style-type: none"> • Soil science, composting • Companion planting • Planting/harvesting schedule • Project management • Legacy projects • Farmer’s market • Sustainability ethics

Kuleana is a Hawaiian word used to describe one's personal sense of responsibility. The kuleana phase is distinguished by a clinical focus on increasing self-regulation and relational health, targeting the diencephalon and limbic regions of the brain associated with attachment, attunement, reward, and emotional regulation (Perry, 2006). Examples of garden activities that support functioning in these areas include parallel planting activities with a trusted adult, followed by a shift to increased peer interaction, nature art, and creative activities focused on the Garden Hierarchy of Needs (Slagle, 2013), caring for early stages of growth in the nursery, transplanting, and exploring cultural variations in agriculture.

Ohana is a fundamental component of Hawaiian culture. The word ohana represents the inherent values of the family system, recognizing the need for balance among all key aspects of life, with nature and community being integral parts of the Hawaiian perspective of family (McCubbin & McCubbin, 2005). Increasing relational health and executive cognitive skills are the primary goals of the ohanaphase. Thus, ohanagardens are designed with a focus on environmental science, collaboration, and individual/group problem solving. During this phase, adolescents and young adults are often reunited with family members to address specific treatment and transition goals while working together as a family unit to complete garden projects aimed at applying communication skills and symbolic meaning.

Huli Ka'e is the pinnacle rites-of-passage experience. Based on indigenous healing practices, clients are provided experimental freedom to engage ritual and ceremony to ultimately uncover their core identity. As clients engage in horticultural activity focused on ancestry, symbol and archetype in nature, play, and transpersonal meaning making, the rites-of-passage garden may engage all functional domains.

Malama is Hawaiian term used to describe the duty to care for and protect one's life and the natural environment and communities that our lives depend on. The malama phase represents the integration of the NMT functional domains and the capacity for cortical modulation and higher order cognitive processing. Insight-oriented approaches are combined with garden activities focused on stewardship and "planting it forward", empowering clients to take an active role in effecting change in their personal lives and within their communities.

Research and Evaluation

After PQ achieved Phase I Site Certification in NMT, Freedle, Slagle, and Freedle (2016) conducted an exploratory study to investigate the effectiveness of the PQ model in treating young adults with emotional dysregulation. A mixed-method, quasi-experimental design was used to evaluate the program. Results were robust, suggesting that the NMT-informed, integrative model is effective in improving emotional and behavioral functioning and relational health in young adults with emotional dysregulation. Preliminary follow-up results showed that these improvements were sustained post-discharge. Furthermore, qualitative findings indicated that participants reported a sense of belonging in the universal order and experienced a state of resonance that was not present when they began treatment. Hence, applying NMT principles in an integrative OBH setting with a focus on horticultural therapy may lead young people to compassionate engagement with themselves, others and their natural environment.

More research is needed to include empirical studies that investigate this model, including evaluation of its various treatment components. The PQ outcomes studies to date consistently show clinically significant improvement that is maintained at follow-up (6 months and one year). Furthermore, PQ participates in the NATSAP Outcomes Research Project. Empirical studies that evaluate client outcomes for programs participating in the NATSAP project have consistently showed clinically significant improvement in client functioning in adolescents and young adults following treatment (Curtis, Briggs & Behrens, 2018). PQ will continue to conduct and encourage further research.

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