Research-Based Perspectives on the Psychophysiology of Yoga

Shirley Telles
Patanjali Research Foundation, India

Nilkamal Singh
Patanjali Research Foundation, India

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Foundations for Yoga Practice in Rehabilitation

Ginger Garner
Professional Yoga Therapy Institute, USA

ABSTRACT

Yoga, as both a science and an art, elicits neurochemical response mediated by neurophysiological mechanisms, and when used in rehabilitation, can honor both its cultural philosophy while evolving as an evidence-based therapy. The central theme of this chapter is to provide a foundation for a novel yogic model of rehabilitation practice using proposed common psychotherapeutic and physiological factors that affect patient outcomes. This model is guided by Ten Precepts that can guide the use of yoga in rehabilitation as a medical, therapeutic, yoga, in order to foster evidence-based practice, which is representative of best practice techniques in rehabilitation. The 10 Precepts include guidelines on optimization of patient assessment and intervention, education, respiratory function as a first-line psychophysiological intervention, fostering stability and safety through six evidence-based neurophysiological principles, inclusion of Ayurveda and other yogic tools, and non-dogmatic yoga practice in rehabilitation.

INTRODUCTION

The science of rehabilitation is a living, changing art. So is yoga. There are benefits to studying both, and even greater value to combining the two in clinical practice. Biomedical care and holistic paths like yoga can bilaterally advance from joining hands as synergistic sciences.

Yoga, as both a science and an art, “elicits a neurochemical response mediated by neurophysiological mechanisms” (Garner, 2016), and its practice in rehabilitation can honor its historical roots and rich cultural philosophy while concurrently evolving as an evidence-based therapy. While biomedical care saves lives with its demonstrated excellence in acute, crisis-based disease intervention (Garner, 2016), it’s weaker record with chronic disease prevention and management (Pomeroy, 2012; Van hecke, Torrance, & Smith, 2013; Elliott, Smith, Hannaford, Smith, & Chambers, 2002) makes yoga, specifically yoga that is evidence-based and evidence-informed, the perfect adjunct to clinical rehabilitation disciplines. Simply put, yoga’s inclusion in healthcare can improve rehabilitation, including its preventive, acute,
and chronic care aspects, while also fostering creative, innovative dialogue that can transform healthcare, now and for the future.

The central theme of this chapter is to provide a foundation for a novel yogic model of rehabilitation practice using proposed common psychotherapeutic and physiological factors that affect patient outcomes. This model is girded by Ten Precepts. They can guide the use of yoga in rehabilitation, a medical, therapeutic yoga, in order to foster evidence-based and evidence-informed practice, which are representative of best practice techniques in rehabilitation.

The Ten Precepts follow and are discussed in this chapter. The evidenced-based practice of yoga in rehabilitation and wellness practice should (Garner, 2016):

1. View the person and their potential for injury or disease through a biopsychosocial model of assessment (Institute of Medicine, 2011; WHO, 2002) in order to affect all-health outcomes through reducing allostatic load.
2. Encourage establishing interdisciplinary integrative yoga education in healthcare (IOM, 2000; Pergolizzi et al., 2013) in order to protect the consumer of yoga and maximize clinical efficacy.
3. Attend to the breath prior to introduction of postures.

Table 1. Review of ten precepts that guide the use of yoga in rehabilitation and wellness care

<table>
<thead>
<tr>
<th>Precept</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. View</td>
<td>View the whole person through a yogic Biopsychosocial (BPS) model.</td>
</tr>
<tr>
<td>2. Establish</td>
<td>Establish interdisciplinary integrative yoga education in healthcare.</td>
</tr>
<tr>
<td>3. Recommend</td>
<td>Recommend attention to breath prior to teaching postures or movement.</td>
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<tr>
<td>4. Advocate</td>
<td>Advocate for BPS stability as a primary focus with mobility as a secondary focus, guided by principles of neurophysiology and biomechanics.</td>
</tr>
<tr>
<td>5. Inform</td>
<td>Inform dynamic execution of breath and postures via instruction of internal or external support.</td>
</tr>
<tr>
<td>7. Include</td>
<td>Include sound, music, and voice analysis as therapy.</td>
</tr>
<tr>
<td>8. Teach</td>
<td>Teach non-weight-bearing headstands and non-cervical-weight-bearing shoulderstands and emphasize protection of vulnerable joints.</td>
</tr>
<tr>
<td>9. Welcome</td>
<td>Welcome all disciplines of yoga and spiritual belief systems.</td>
</tr>
<tr>
<td>10. Guide</td>
<td>Guide the student to seek the self pursuant to one's duty/mission.</td>
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</table>

4. Advocate for biopsychosocial stability as a primary focus with mobility as a secondary focus, pursuing structural alignment of postures guided by six physiological principles.

5. Inform dynamic execution of breath and postures via: 1) internally supported postures (Asana) or 2) passive rehabilitation methods via externally supported postures (Asana) based on the value of their functional carryover to ADL’s (activities of daily living), like walking or lifting items, for example.

6. Combine Ayurvedic (sister science and medical side of yoga) clinical evaluation methods for analysis in yoga prescription.

7. Include evidence-based sound, music, and voice analysis as therapy to affect allostatic load, systemic inflammation, neural plasticity, and/or ventral/myelinated vagus nerve stimulation via pre-frontal cortex, motor cortex, cranial nerves and cardiorespiratory neural mechanisms, which also exert influence on pressure systems that affect laryngeal/thoracic, respiratory, and pelvic diaphragms.

8. Teach non-weight-bearing headstands (sirṣaṣana) and non-cervical-weight bearing shoulder stands (salamba sarvangaṣana), emphasizing protection of vulnerable joints that include the small joints of the hands, feet, and the spine and pelvis.

9. Be non-dogmatic and welcoming to all disciplines of yoga, respecting all spiritual belief systems.

10. Guide the practitioner to seek the self, pursuant to one’s duty/mission (dharma).

**Precept 1: View the Person and Their Potential for Injury or Disease Through a Biopsychosocial Model of Assessment in Order to Affect All-Health Outcomes Through Reducing Allostatic Load**

First introduced by the pioneering efforts of Engel (1977), the biopsychosocial model was endorsed, with a considerable gap in time, by the World Health Organization (WHO, 2002) and the Institute of Medicine (2011) as the most effective and cost-effective means for patient care, particularly in pain management. The first precept serves to optimize assessment in rehabilitation using a yoga-enhanced biopsychosocial model, since the difference between therapy delivered in the historical medical model and therapy delivered using yoga is found in the term “biopsychosocial” (Garner, 2016).

The origin of the modern yogic biopsychosocial conceptual model in rehabilitation is two-fold, based on recommendations from the WHO’s ICF model (2001), the IOM (2011), and an evolution of the five-limbed yogic BPS (panca [five] maya [pervading]) model (Garner, 2016; Easwaren, 2007). The synthesis of these once binary practices into a yogic biopsychosocial model may optimize patient assessment and care because the model looks at the person and their potential for injury or disease as a whole, rather than through the lens of a single diagnosis or through the linear scope of a diagnosis-seeking paradigm. The model can offer a more comprehensive view of health and impairment in the individual by drawing conclusions about health from a systems-based perspective via consideration of environmental and personal factors. These can include but are not limited to social support, perceived locus of control, self-efficacy, and motivation, all of which influence the outcome of medical or rehabilitative care, perhaps even more than the actual biomedical care delivered. The biopsychosocial model has been validated with a multitude of populations, including orthopaedic, neuromuscular, and psycho emotional/mental health ranging from pediatric to geriatric patients (Garner, 2016; Harris, Macdermid, & Roth, 2005; Ayuso-Mateos, Ávila, Anaya, Cieza & Vieta, 2013; Conrad, Coenen, Schmalz, Kesselring & Cieza, 2012; Glocker et al., 2012; Oberhauser et al., 2013; Rudolf et al., 2012; Scorza et al., 2013).
The five dimensions of the yogic model are described in the *Taittiriya Upanishad*, titled as “Ascent to Joy” or degrees of happiness (Easwaram, 2007):

1. Material body, physical and nutritional sheath (Annamaya [ahn-nuhn mah-yuh])
2. Vital sheath, Energetic body, life force, breath (Pranamaya [prah-nuhn mah-yuh])
3. Mind, emotional, social body, discrimination (Manomaya [mahn-nohmah-yuh])
4. Intellectual body, wisdom/discrimination (Vijnanamaya [vignyah-nuhn mah-yuh])
5. Bliss body, spiritual, individual connected with the divine/soul (Anandamaya ([ahn-nahn-duh mah-yuh])

Use of the model in the yogic system requires 1) recognition that psychobiological health is affected by personal and environmental factors and that the current biomedical clinical practice paradigm, as a result, must evolve; and 2) addressing all five dimensions in the model. “Each one is valuable and critically interrelated in a circuitous relationship rather than a hierarchical one” (Garner, 2016).

The next step is exploration of the hindrances to use of the model, known in yogic philosophy as obstructions (*kleshas*). Study of these five obstructions (*kleshas*) exemplifies the yogic model’s potential for recognition of impairment and factors responsible for impeding or preventing health and well-being.

*Figure 1. The yogic biopsychosocial model: a pentagon of wellness*
which can help rehabilitation professionals understand and identify how an individual’s life experiences ultimately shape their health outcomes, a primary intention of the yogic biopsychosocial model.

The five obstructions are ignorance (*avidya*), said to be the most important because it creates conditions for the remaining four obstructions to exist. Following are the remaining four: egoism (*asmita*), attachment (*raga*), hatred or aversion (*dvesha*), and clinging to life (*abhinivesah*) (Iyengar, 1976).

Overcoming obstructions to health is not the goal in yoga, nor is it possible in life. B.K.S. Iyengar, in the quintessential text of early western yoga instruction, *Light on Yoga*, states that the obstructions can be active, latent, or hidden; they are never absent (1976). This means that the intention rests in creating awareness of the obstructions and working with them either as they arise or in the spirit of prevention. In this way, the WHO ICF and obstructions (*kleshas*) models are synergistic, both focused on active, patient-led, and person-centered care.

The inherent wisdom of recognizing obstacles to wellness acknowledges that if we can understand a person’s likes, dislikes, fears, and loves, then we can plan more effective medical intervention. (Garner, 2016)

Successful work with these obstructions depends on more than just rote study and academic application of philosophy and its conceptual model, however. It depends on yoga’s primary teaching tool, experiential practice. To use yoga in rehabilitation, it must be personally practiced. In this way, yoga offers a beautiful solution for not only improving patient care, but practitioner care as well. Acknowledging these obstructions can be a catalyst for adopting the yogic biopsychosocial approach, which requires either a) starting or b) deepening a personal yoga practice.

The second condition for using the model is recognizing that the limbs do not exist in a vacuum. For example, patient outcomes in both psychotherapy and physical therapy can rarely be attributed to a single intervention (Wampold, 2001). Rather, through introduction of a “Common Factors Model (CFM),” systematic reviews in psychotherapy posit “diverse therapeutic interventions indicate that factors common across therapies contribute more to treatment outcomes than a specific technical intervention” (Miciak et al., 2011). There are four critical factors in the CFM that contribute to treatment outcomes: 1) therapist qualities, 2) relationship element and treatment structures (i.e. therapeutic landscape), 3) client characteristics (i.e. self-efficacy, health literacy, health beliefs), and 4) change processes or readiness (Grencavage & Norcross, 1990). Each of these variables can either hinder (if neglected) or improve (if attended to) health and quality of life, and can be addressed through the yogic biopsychosocial model. This opens the path to discussing the yogic philosophy of obstructions (*kleshas*) to practice.

*Figure 2. The five obstructions (Kleshas)*

<table>
<thead>
<tr>
<th><em>Kleshas</em></th>
<th><em>Obstructions</em></th>
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<tbody>
<tr>
<td><em>Avidya</em></td>
<td>Ignorance</td>
</tr>
<tr>
<td><em>Asmita</em></td>
<td>Egoism</td>
</tr>
<tr>
<td><em>Raga</em></td>
<td>Attachment</td>
</tr>
<tr>
<td><em>Dvesha</em></td>
<td>Hatred/Aversion</td>
</tr>
<tr>
<td><em>Abhinivesha</em></td>
<td>Clinging to the Body</td>
</tr>
</tbody>
</table>

A leading candidate for affecting global health is focusing on patient education, especially when health literacy is considered an epidemic public health problem and key determinant of poor health and poor lifestyle management both in the United States and worldwide (WHO, 2013; US Dept. Health Human Services, 2010). Not surprisingly, optimizing patient education in the rehabilitation experience is also congruent with overcoming what is said to be the most important obstruction (klesha) in yoga practice, ignorance (avidya). Nonetheless, healthcare providers have to work within a system where third-party payers give inversely proportional value to patient education, an ironic but nonetheless real obstacle to overcome in order to improve care.

The remaining four obstructions can heavily influence a person’s outlook on life through affecting their opinion of stress. To avoid stress, whether it is avoiding difficult work or challenges, or avoiding strong emotions, whether sad, angry, or happiness or joy, is to avoid growth. Yogic philosophy posits an individual who actively and consciously avoids, is led by ego, or is not interested in learning, and is by definition, obstructed from aspiring to yoga, or full living. Yet, “viewing stress and pain as a teacher or friend instead of the enemy can improve long-term health outcomes, health status, and quality of life,” all vital pursuits of the yogic lifestyle (Garner, 2016; Nabi et al., 2013; Nygaard & Heir, 2012; Keller et al., 2012).

To review, successful use of the yogic biopsychosocial model depends on two elements, a) empathic, holistic, person-centered care through considering the five-limbs mentioned above, and b) recognizing and addressing the inherent difficulties in its application through study of the obstructions (kleshas). In order to nurture betterment we must first understand where we are and how we arrived. Biomarkers for determining successful application of the yogic biopsychosocial model can consider:

1. Identifying objective evidence of reduced allostatic load, which determines all-health outcomes due to its influence on pain (Goldberg & McGee, 2011), stress, sleep, fatigue (Rohleder, Aringer & Boentert, 2012), age-related disease (Danese & McEwen, 2012; Taylor, Way & Seeman, 2011), and epigenetic impact, including longevity (Morris, Lay & Allison, 2012). Allostatic load is defined as “the cost of chronic exposure to fluctuating or heightened neural or neuroendocrine response resulting from repeated or chronic environmental challenge that an individual reacts to as being particularly stressful.” (McEwen, 1993). McEwen (1998), McEwen and Seeman (1999) simplified the term by defining it as wear and tear on the body systems due to physiological adaptations to repeated stressors (Garner, 2016).

2. Measuring patient satisfaction and improved quality of life through standardized evidence-based measures such as the validated SF-36 (short-form) (Quality Metric, 2016; Lim, Seubsman & Sleigh, 2008; McHorney, Ware Jr, Lu & Sherbourne, 1994) or other psychometric inventories.

If stress (and the individual’s stress response) is indeed a psychobiological phenomenon (Morris, Lay & Allison, 2013; Beckie, 2012) that, under sustained social or economic circumstances, can perpetuate adverse autonomic response and skew cortisol levels toward chronic disease and abbreviated longevity (Goldberg & McGee, 2011); and, if the dharma (duty) of yoga seeks balance and unity both internal and external to the individual, then the chief intention of yoga would indeed be allostasis. Reducing allostatic load is chiefly concerned with affecting the HPA-Axis (hypothalamic-pituitary-adrenal axis) due to its established relationship with cortisol dysregulation (Streeter, Gerbarg, Saper, Ciraulo & Brown, 2012; Friedman, Karlamangla, Almeida & Seeman, 2012; McVicar, Li, Suchý, Hudson, Menon & Bartha, 2013; Beckie, 2012, Logan & Barksdale 2008, Ross & Thomas, 2010). Determinants of allostatic load
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include genetic, environmental, biographical, psychosocial, and behavioral (lifestyle choices such as diet, activity, and sleep) clinical variables in the individual (Beckie, 2012). The multi-variate nature of allostatic load further underscores the need for a multi-faceted biopsychosocial approach, or one that bridges the fields of biomedical and psychosocial stress management and care (Garner, 2016; Beckie, 2012; Pergolizzi et al., 2013; WHO, 2002). Yoga is capable of reducing biomarkers of inflammation in order to improve immune function, per a 2014 meta-analysis (Morgan, Irwin, Chung, & Wang, 2014). If true, use of the yogic biopsychosocial model in patient care to reduce allostatic load may well be the first and most important precept of applying best-evidence yoga in rehabilitation.

Precept 2: Encourage Interdisciplinary Integrative Yoga Education in Healthcare in Order to Protect the Consumer of Yoga and Maximize Clinical Efficacy

There are additional hindrances to the application of the yogic biopsychosocial model. Those hindrances, or kleshas, are identified limitations or barriers inherent in both humanity and organizational structure alike, and can present in various ways.

In the field of rehabilitation, these limitations may stem from a) the branches of medicine and yoga continuing to practice in silos, which is driven by historical dependence on the dominator model in healthcare and yoga systems, and/or b) social or cultural conditioning that influences practitioner and/or patient perspectives and which limit or impede delivery of care.

Best evidence for health and medical education supports interdisciplinary, integrative instruction (IOM, 2013; Pergolizzi et al., 2013). Lack of necessary pedagogical evolution will perpetuate poor health literacy between professions, which means health care providers will continue to misunderstand or remain ignorant about the services their colleagues in medicine or rehabilitation can well provide.

This argument could be made to evolve not only medical but evidence-based yoga education in health care, since the primary impetus should be consumer and patient safety and clinical efficacy. To foster this evolution, creativity and innovation must be valued in yoga education in health science fields alike, and its primary vehicle may be via shifting status quo medical education and clinical practice toward a new relational paradigm that embraces partnership.

The first step in pursuing a new paradigm is to look at how we, as a collective rehabilitation field, view the world, known as phenomenology. Yoga offers just such a view, “another way of being in the world” (Anderzén-Carlsson, Lundholm, Köhn, & Westerdahl, 2014). In contrast, current educational and practice paradigms often view the patient as someone who is a passive receiver of care, rather than a decision-maker and stake-holder in her/his healthcare. Again, this perpetuates the global health literacy problem and by proxy, poor global health.

From a global healthcare perspective, almost 70 years have passed and the collective medical community has yet to create healthcare systems that fully embody the World Health Organization’s definition of health as being “a state of complete physical, mental, and social well-being and not merely an absence of disease” (WHO, 1948). By contrast, healthcare costs continue to rise and are inversely proportional to the quality of care that should be a basic human right. Yoga is a low cost, effective means for recognizing that definition of “health” and manifesting it across the globe, especially when it is more effective when combining it with the familiar evidence-based practices in rehabilitation.

The 20th century witnessed a shift in medicine from acute disease to chronic and lifestyle and disease management (Dean et al., 2011; Wahdan, 1996), which underscored a critical need for a shift in thinking
in healthcare (Garner, 2016; Pomeroy, 2012; Van Hecke, Torrance & Smith, 2013; Elliott et al., 2002). And yet, reform is not happening at a rate fast enough to address the opiate epidemic or the soaring rates of chronic disease (WHO, 2005) reported by the Centers for Disease Control (2016).

35 of 58 million deaths in 2005 were preventable because of their direct attribution to chronic disease (WHO, 2005), while chronic pain is also on the rise globally (Van Hecke et al., 2013).

Clearly, the way medical education is approached should evolve.

Meanwhile, a 60-year meta-analysis shows some support for yoga as a potentially “superior” intervention to conventional standard physical activity in the geriatric population (Patel, Newstead & Ferrer, 2012). Yoga is also effective for a range of chronic disease processes and addiction issues through affecting biomarkers for inflammation such as C-reactive protein (CRP) and cytokines, cardiovascular, psycho-emotional and physiological health, and immune function (Ross & Thomas, 2010; Pullen et al., 2008; Bijlani et al., 2005; Tekur, P., Nagarathna, Chametcha, Hankey, & Nagendra, 2012); Streeter et al., 2012; Kuntsevich, Bushell & Theise, 2010; Kochupillai et al., 2005), the very drivers that precipitate the need for a change in education and clinical practice.

Yoga’s growing body of evidence offers a multi-faceted methodology including breath work, meditation, movement, and lifestyle counseling, which can affect what the WHO (2005) identifies as the largest risk factors for premature aging and mortality, including unhealthy diet, physical inactivity, poor lifestyle choices that lead to obesity, cardiovascular disease, diabetes, and several types of cancer (Garner, 2016). There are other variables to consider in the convergence of yoga philosophy with today’s medical model:

- Our current education in rehabilitation must recognize the multiple systemic and organizational entry points for intervention, rather than just addressing the physical or a single system or disease process.
- Inter professional learning needs more attention in health care (Hall and Weaver 2001), while a multidisciplinary approach is essential to decrease patient catastrophizing, self-reported patient disability, pain relief and to improve physical functioning, emotional stress, depression, and quality of life (Pergolizzi et al., 2013).
- Medical education in rehabilitation fields must shift to reflect a systems-based approach to evaluation and management, one that improves access to conservative care and prevention of chronic pain and disease processes and injury via evolving rehabilitation professionals role to match frontline care in the medical model.
- Research on yoga should evolve through embracing an interdisciplinary model that would measure the effects of combining rehabilitation science with evidence-based yoga, instead of continually pitting one against the other in perpetual “silos-type” studies.
- Our paradigm of care must shift to one that places the patient in an active (rather than passive) role in her/his healthcare.

Accomplishing all of these variables begins through changing healthcare culture, which requires challenging the status quo of organizational and social infrastructure. To pursue this cultural evolution, effective communication is paramount, which depends on relationship, or more specifically, one based on partnership. Relationship drives partnership theory and is recognized as moving from a domination-based interaction to a partnership (Eisler & Potter 2014). In partnership theory in healthcare, for example,
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a person is empowered to become an active participant of his or her health care instead of a passive patient. This would allow the individual to take responsibility for his or her care instead of just being a submissive recipient of “doctor’s orders,” and would also foster creativity and innovation in rehabilitation (Garner, 2014).

Rehabilitation education and our creative discourse, both requisites for innovation, can improve if we consider a shift toward partnership (Garner, 2014). “Partnership theory values historically marginalized qualities attributed as stereotypically feminine, including compassion, softness, nurturing, empathetic listening, and nonviolent collaboration” (Garner, 2014). These qualities have largely been treated as inferior to “masculine qualities,” like dominance, toughness, conquest, power, authority, force, and strength of will (Eisler, 2007). In medicine, these qualities are often personified in the “power of the white coat” (Garner, 2014). A first step toward shifting away from the dominator model of the “doctor as god” complex is to consider the language we use in interacting with patients, which should be positive and enabling (rather that disabling) (Figure 3).

Overall, the positive influence of yoga philosophy on medical education could improve variables such as self-efficacy, locus of control, patient adherence, self-management, and confidence, all major factors in affecting the chronic disease epidemic and which were found to influence yoga participation in an analysis of 2468 internal medicine patients (Cramer et al., 2013). Inclusion of a partnership model for collaborative practice in healthcare across medicine, rehabilitation, and yoga fields may also improve access to and coordination of healthcare services, improve chronic disease outcomes, promote appropriate use of specialist medical and rehabilitation services, reduce length of hospital admissions, stays, and readmissions, improve patient safety, reduce patient complications, clinical error rates, and overall mortality rates and research potential. Use of best-evidence instructional design through adoption of the partnership model and via fostering interprofessional education and research may improve patient satisfaction, reduce healthcare costs, reduce suicide rates of patients and practitioners, provider outpatient visits, and improve access to mental health care (Eisler & Potter 2014; Garner, 2014; WHO 2010).

Precept 3: Respiratory Function Should be a First Line Psychophysiological Intervention

Sensory modulation is a controversial topic that affects everything from pain neuroscience theory and pain management to the science of stretch and flexibility. However, one constant in the scientific debate about sensory modulation is that the breath is sovereign, affecting all systems of the body (Garner, 2016). The ability to optimize respiratory function is driven by, in part and perhaps more than biomedical science currently understands, the 10th cranial nerve, the “wandering,” vagus nerve. For this reason and others which will be explained in this section, the breath should be attended to prior to teaching, prescribing, or encouraging therapeutic movement or postures (Asana). In short, the breath should precede the yoga posture in prescriptive focus.

There are two functional breath types that should be considered perfunctory before instructing yogic breathwork (pranayama). These are the abdomino-diaphragmatic (AD) breath and the transversus-abdominis-assisted thoraco-diaphragmatic (TATD) breath (Garner, 2016).

The AD breath is used for restoratives and neuroendocrine regulation, invoking a relaxation response and teaching basic coping mechanism and resiliency, based on polyvagal theory. Its chief mechanism is to optimize the stress response, but it can also assist in inducing sleep and deeper relaxation or meditation.
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Figure 3. Two contrasting social configurations: The domination system and the partnership system

System and the Partnership System. Three principle statements guide the interpretation of the systems.

1. Transcending conventional categories such as right or left, religious or secular, ancient or modern, capitalist or socialist, and Eastern or Western, the partnership system and the domination system are two basic ways of structuring human societies.

2. No system is a pure partnership or domination system. It is always a matter of degree that depends on where it is situated on a partnership/domination continuum.

3. The degree to which a society orients to the domination or partnership configuration directly affects its beliefs, institutions, and relations – from intimate to international.


By contrast, the TATD breath could be described as a kind of “power breath,” used for task-dependent optimal psychobiological arousal when global or regional stabilization is required during ADL completion or yoga, such as lifting one’s own body weight in a yoga posture, during childcare or household management, or work task completion. The chief neural mechanism of TATD breath is provision of lumbopelvic stability and optimization of pressures between the three (laryngeal, respiratory, and pelvic) diaphragms, with psychobiological safety as its duty (dharma).
Prerequisites for teaching AD or TATD breath include a screen of the orofacial area, which is outside the scope of this chapter but found in the text Medical Therapeutic Yoga (Garner, 2016). This screen identifies orofacial and/or respiratory dysfunction, which could include*:

- Cervical and/or thoracic spine (bony) or extrinsic laryngeal (soft tissue) maladaptations (see table 3 for details) that can increase larynopharyngeal pressure and contribute to swallowing or phonation problems.
- Increased supraglottal pressure, a major contributing factor in muscle tension dysphonia (Tomlinson & Archer, 2015) which carries implications for pelvic girdle pain, postural stability, and respiratory diaphragm dysfunction (Holstege, 2016; Holstege & Subramanian, 2014; Massery, Hagins, Stafford, Moerchen, & Hodges, 2013).
- Mask breathing, a condition that involves elevated muscle tension in the low threshold motor units of the extrinsic laryngeal muscles, which effect laryngeal function and by proxy, pressures on the respiratory and pelvic diaphragms.
- Chest breathing, a condition that results in disuse of the respiratory diaphragm and a silent abdomen that does not expand on inspiration.
- Paradoxical breathing, reverses the normal physiological state of diaphragm descent during inspiration, and is characterized by a passive diaphragm that is drawn superiorly while the external intercostals flare the ribs laterally and the abdominal wall is pulled superoposterior by the inverse vacuum action of the passive diaphragm.

<table>
<thead>
<tr>
<th>Functional Breath Type</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Abdomino-diaphragmatic (AD) Breath</td>
<td>Relaxation breath, foster sleep, restorative yoga, neuroendocrine regulation, pain management, coping, resilience, vagal tone</td>
</tr>
<tr>
<td>Transversus abdominis-assisted thoraco-diaphragmatic (TATD) Breath</td>
<td>Power breath, task-dependent optimal psychobiological arousal when global or regional stabilization is required during ADL completion or yoga, such as lifting one’s own body weight in a yoga posture, or during childcare, household management, or work task completion. Chief neural mechanism of TATD breath is provision of lumbopelvic stability and optimization of pressures between the three (laryngeal, respiratory, and pelvic) diaphragms, with psychobiological safety as its duty (dharma).</td>
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Table 3. Dysfunctional breath/orofacial considerations

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<thead>
<tr>
<th>Dysfunctional Breath &amp; Orofacial Considerations</th>
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<tbody>
<tr>
<td>• Cervical spine maladaptations, such as but not limited to loss of cervical spine lordosis, cranium-C1 glide, C1-2 rotation, and/or loss of C2-C7 vertebral mobility and/or stability; extrinsic laryngeal soft tissue restriction, increased tone at rest, or hyper-recruitment</td>
</tr>
<tr>
<td>• Increased or abnormal supraglottal, respiratory diaphragm, or pelvic diaphragm pressure</td>
</tr>
<tr>
<td>• Mask breathing</td>
</tr>
<tr>
<td>• Chest breathing (also called clavicular or thoracic breathing)</td>
</tr>
<tr>
<td>• Paradoxical breathing</td>
</tr>
<tr>
<td>• Open-mouthed breathing</td>
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<tr>
<td>• Shortened lingual frenulum (tongue tie)</td>
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*Medical Therapeutic Yoga outlines orofacial and respiratory screen overview (Garner, 2016).

- Open-mouthed breathing, an indicator of low facial tone and myofunctional dysfunction of the orofacial complex which could correlate with a sequelae that includes poor proprioception in the face/mouth with possible low global tone, diminished respiratory capacity, hypermobility syndromes like Ehlers-Danlos (DeFelice, Toti, Di Maggio, Parrini & Bagnoli, 2001), postural dysfunction (Conti, Sakano, Ribeiro, Schivinski, & Ribeiro, 2011; Olivi, G., Signore, Olivi, M., & Genovese, 2012), sleep apnea, temporomandibular joint dysfunction, and bruxism Pediatric issues related to open-mouth breathing, which is a paradoxical opposite of mask breathing, can include adverse dentofacial and craniofacial development (Harari, Redlich, Miri, Hamud, & Gross, 2010) that can lead to cervical, temporomandibular, and postural malalignment.

- A shortened lingual frenulum, or tongue-tie, may be identified.

The resulting affect (regional and/or facial) from identification of orofacial dysfunction and/or abnormal respiratory patterns can have a (systems) effect, most directly, through poor vagal response which can immediately increase allostatic load via perpetuating persistent states of sympathetic “fight, flight, or freeze” response that constantly bombards the central nervous system with “neural noise”. This prevents development of any relaxation, stress management, or coping mechanisms.

Polyvagal theory also posits that a dorsal vagus circuit (DVC) response could cause detachment, dissociation, or “shut down,” through its unmyelinated branch (Porges 2001, 2011).

This “shut down” response moves beyond the mere “freeze” response, as it is characterized as an immobilizing action or one where the individual is immobilized with (rather than without) fear. The opposite response would be a ventral vagus circuit response where a person can be immobilized without fear, as in receiving and giving physical contact like a hug, or being in a restful, restorative yoga pose.
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Figure 4. The polyvagal theory: A unifying psychobiological theory in medicine

“X” stands for cranial nerve X (10), as well as the key variable for provision of the 10 precepts for yoga practice. The infinity sign represents a meta-view of polyvagal theory, by which memories feed-forward into the neural mechanism that will determine human action based on vagal response. In a clockwise fashion, memories are created or recalled based on sensory modulation, interpretation, or input. Stress response is dictated by two possible pathways, a bio/ bidirectional path that leads to a ventral (myelinated) vagus circuit response (VVC), or one that represents dysregulation and leads to either a sympathetic or dorsal (unmyelinated) vagus response (DVC). In the VVC response, a person is able to socially engage, make a heart–face connection, respond to perceived stress with resilience, able to appropriately detect risk (neuroception), and accept physical contact without threat (immobilization with fear), for example, as in receiving a hug or being in a restorative yoga pose with weighted props such as a sandbag (indicated by the figures of people holding hands and performing restorative yoga). The sympathetic response would be a classic, fight, flight, or freeze response, indicative of running toward, running away, or analysis paralysis fear-based reaction. Sympathetic-driven neuroception which is inappropriately and perpetually interpreting everyday situations as high risk or high threat, which can lead to sustained HPA (hypothalamic-pituitary–adrenal) axis response causing neuroendocrine dysregulation and increased allostatic load. The individual cannot receive a hug (an example of immobilization which is safe and welcome under a VVC response) and would respond with fight, flight, or freeze. This situation is an example of immobilization with fear, a classic sympathetic nervous system response. The DVC response is the most dangerous, which leads to shut down of all systems. The person cannot socially engage, make a face–heart connection or respond to others’ concern, leading to flat affect, dissociation, and non-responsiveness from the individual.

without perceiving danger and responding with dissociative behaviors. See figure 4. Since allostatics is a chief neural intention for application of yoga as therapy in rehabilitation, once again, breath emerges as a clear priority in medical yoga intervention.

Respiratory rate has become a neglected vital sign (Cretikos et al., 2008; Gandevia & McKenzie, 2008), with the literature varying on what qualifies as hyperventilation. A respiratory rate over 20 breaths/minute is generally accepted as a hyperventilation state, while a rate of over 24 breaths/minute could qualify a patient as critically ill (Cretikos et al., 2008). Neuroanatomical implications of faulty respiration include periodontal, cervical, and upper thoracic impairment, cardiovascular dysregulation, functional gastrointestinal dysfunction, psychoemotional distress and neuroimmunological pathogenesis including proinflammatory activity, reproductive, urological, and sexual dysfunction, and lumbopelvic and myofascial impairment (Garner, 2016).

The physical bodywork of yoga postures alone may not be sufficient to change the physiological response and reorient an organism toward the myelinated ventral vagus circuit (VVC) response (Garner, 2016). State trait behaviors of VVC response include:

- Social engagement behaviors
- Positive affective experiences
- Relationship building
- Spiritual readiness, and
- Safety

All of these characteristics are desired responses in both rehabilitation and yogic intervention, therefore, focus on improving the VVC response through functional breathwork via sensory and motor inputs of the vagus nerve to the crural diaphragm and the phrenoesophageal ligament (Young, Page, Cooper, Frisby, & Blackshaw, 2010; Bordoni & Zanier, 2013) should be a chief clinical goal.
An additional important entry point for affecting VVC function is via alternate routes for vagal stimulation, chiefly through afferent motor inputs to trigeminal and hypoglossal nerve function (Finsterer & Grisold, 2015) and through the vagus’ auricular branch.

High value should be placed on sound, music, and vocal production, intonation, and modulation, from the patient, practitioner, and/or surrounding environment, for intervention, especially in those with documented history of a sympathetic (fight, flight, or freeze) or DVC (shut down) response. Cultural and social sensitivity are requisite for adept clinical real time assessment of the response, which is absolutely critical for delivering yoga safely and responsibly in a healthcare setting. For example, vocalization (via chanting or vocal toning or other methodology) is not a universal cure-all capable of “correcting” vagal tone. In some could elicit a DVC or sympathetic response if cultural context, previous medical history, 

Figure 5. Phonation physiology and ventral vagus circuit relationship

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orofacial functioning including evaluation of any existing abnormal breath patterns, and history of previous illness are not carefully evaluated and differentially diagnosed prior to initiating treatment. This makes those with extensive patient care experience and who can evaluate, diagnose, and prescribe or treat, as well as who have pursued therapeutic yoga studies, the ideal candidate for prescribing yoga to those populations at high risk for sympathetic or DVC response, such as military service members who have seen combat experience or other trauma or closer to home, mothers with birth trauma, or women or men who have been victims of sexual or violent assault or abuse.

FUNCTIONAL BREATH PATTERNS

The AD Breath

Diaphragmatic assessment and intervention through the yogic biopsychosocial lens of precept one could help manage esophageal reflux, scalene hypertonicity, subclavius dysfunction, polyvagal dysregulation, thoracic outlet syndrome (TOS), pelvic floor dysfunction, cervical/neck symptoms, dental pain, pain perception, postural control, balance, and cardiopulmonary health (Garner, 2016). A-D breath is perhaps the most readily adaptable voluntary mechanisms by which to affect autonomic change, especially when provided within a yogic context (Turankar et al., 2013; Pinheiro, Medeiros, Pinheiro, & Marinho, 2007; Joseph et al., 2005; Jerath, Edry, Barnes & Jerath, 2006). Through dose response via repeated exhalation, it can affect hemodynamic function (Parshad, Richards & Asnani, 2011), cognition and attention (Balasubramaniam et al., 2012) neuroendocrine regulation, mental health, cardiopulmonary and cardiovascular functioning (Jyotsna et al., 2013), and vocal and speech functioning and facial affect related to conditions like autism spectrum disorder (ASD). Other patient populations include improvement of pulmonary functioning in stroke patients via modulation of diaphragm control via neuromuscular re-education (Jung, Shim, Kwon, Kim & Kim, 2014).

The AD breath is the chief requisite for learning yogic breathing (pranayama) and a gold standard for at-rest breathing. An orofacial and respiratory assessment should be conducted first (Garner, 2016) to identify any red flags that would impair function or breathwork progression. The AD breath can lower arousal state, which is conducive to relaxation, sleep, and yoga postures that do not require dynamic or active strength or stabilization to perform. The breath is characterized by a concomitant passive descent of both the respiratory and pelvicdiaphragms on inspiration, with an unobstructed relaxed glottal opening (laryngeal diaphragm). Exhalation returns all three diaphragms to resting state.

AD breath fosters induction of inhibitory neural impulses to baroreceptors, (blood pressure and heart rate monitors) in the carotids (Jerath et al., 2006) during diaphragmatic descent. This action stimulates the Slow Adapting Stretch Receptors (SARS) that downregulate sympathetic tone. A symphony of systemic action working toward allostasis follows in cardiovascular, pulmonary, immune, neuromuscular, neuroendocrine (through decreased salivary cortisol and downregulation of the hypothalamic-pituitary-adrenal axis), gastrointestinal system function (Sivakumar, Prabhu, Baliga, Pai & Manjunatha, 2011; Turankar et al., 2013; Jerath et al., 2006; Jyotsna et al., 2013; Adhana, Gupta, Dvivedi & Ahmad, 2013; Kuntsevich et al., 2010) and heart rate variability (Tekur, Nagarathna, Chametcha, Hankey & Nagendra, 2012). Refer to Figure 7 to observe a “yoga couch,” a resting position that supports spinal neutral, or the maintenance of spinal neutral during relaxed breathing. More advanced practitioners can work outside of spinal neutral once AD breath is mastered while maintaining the spinal curves.
The TATD Breath

TATD breath requires concomitant recruitment, and sometimes pre-firing (conscious recruitment prior to movement) of three yogic locks and awareness of all three diaphragms discussed in the orofacial section. (See Figure 8)

The diaphragms employed are the thoracic or laryngeal diaphragm, the respiratory diaphragm, and the pelvic diaphragm (see Figure 9) and the locks that are implicated, also called bandhas or seals in yoga, are described in Table 4.

Through increase in intra-abdominal pressure (IAP), intra-thoracic pressure (ITP), and sub-glottal pressure, optimal TATD breath, as well as sound production, can be achieved. The locks system provides a mechanism for tangible physiological recruitment or relaxation (uptraining or downtraining) of joint/muscle complexes in the body. There are also esoteric energetic claims made for employing the locks that
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Figure 7. Yoga couch


Figure 8. Tri-diaphragmatic action of TATD breath

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are outside the scope of this chapter because the system of locks described here differs from traditional descriptions, endeavoring to establish an evidence-base for their clinical indications in rehabilitation.

Functional tasks such as squatting, coughing, vomiting, micturition, defecation, parturition, and sexual activity are also dictated by optimal arousal (pressurization and lock recruitment or relaxation), which requires TATD breath at various levels of isometric functioning or release. However, TATD breath has not only physiological origins for control of basic ADL’s but also strong psychobiological mechanism at work via the emotional motor system.

Through inputs from the limbic system, which can be under conscious control and affected by, yoga practice, the periaqueductal gray (PAG) coordinates cardiovascular, respiratory, motor, and pain modulatory responses (Benarroch, 2012). The PAG, as an interface for behavioral control and located between the forebrain and lower brainstem, has a major role in neuroception. Neuroception (Porges, 2011) is defined as our ability to detect internal (pain) or external (threat). The PAG is a central control for overall arousal, also including thermoregulation and vocal control as evidenced by someone’s response to stress – i.e. getting chills, lumps in the throat, sweating uncontrollably, or getting tension or cracks in the voice or tremors.

Stress, then, is as unfavorable for motor control and safety of the trunk during say, a lifting exercise, as it is for a singer or speaker with stage fright or a mother whose birth “stalls” for “fails to progress” due to

Figure 9. Three diaphragms

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Table 4. Yogic locks

<table>
<thead>
<tr>
<th>Primary Yogic Locks</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal lock</td>
<td>Task-dependent recruitment of the transversus abdominis that concomitantly increases IAP, ITP, and SBP with simultaneous recruitment of the roots locks. Abdominal lock is not typically performed in isolation. Abdominal lock can also employ recruitment of the multifidi of the spine.</td>
</tr>
<tr>
<td>Anterior root lock</td>
<td>Task-dependent recruitment of the anterior pelvic floor (PF) (see figure 11)</td>
</tr>
<tr>
<td>Posterior root lock</td>
<td>Task-dependent recruitment of the posterior pelvic floor, the levator ani group (see figure 11). Recruitment of the pelvic floor using coordinated function of the TA and PF muscles can aid in resolution of incontinence via diaphragmatic retraining (Hung et al. 2010). This increased PF muscle strength can be accentuated using other yogic breathing techniques such as overcoming breath (Ujjayi), which fosters forced expiratory flow, found in a 2010 study to improve PF strength and response (Talasz et al.).</td>
</tr>
<tr>
<td>(synergistic for TATD breath)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Yogic Locks</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chin lock</td>
<td>5-10 degrees of glide of the cranium over C1 (first cervical vertebra) without cervical flexion or involvement of C2-C7.</td>
</tr>
<tr>
<td>Shoulder lock</td>
<td>The periscapular muscles are instrumental in healthy load transfer from the upper extremity, in concert with the rotator cuff, through the torso and spine. TATD breath is regionally interdependent on the muscles of the periscapular area, which are responsible for scapulothoracic kinesis and scapulohumeral rhythm. The force couple in this lock would include scapular depression, internal rotation, and medial rotation without over-recruitment of the rhomboids, which would result in &quot;military posture&quot; and underutilize the critical lower trapezius and serratus anterior.</td>
</tr>
<tr>
<td>Hip lock</td>
<td>The hip lock provides a deep gluteal sling or hip &quot;rotator cuff&quot; force couple for synergistic strength in TATD breath. These muscles include the superficial gluteals, gluteus maximus, medius, and minimus, and the deeper hip cuff or sling, which includes the piriformis, gemellus superior and inferior, the obturator internus and externus, and the quadratus femoris. A full discussion of these muscles are outside the scope of this text due to their widely varied function, but collectively they act to provide stability to the lumbopelvic complex, particularly in the hip and knee.</td>
</tr>
</tbody>
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Ginger Garner DPT, ATC/LAT, PTT

bright lights, noises, and unwanted interruptions and prodding by well-meaning health care providers in the stark, often dehumanizing hospital setting. We, as a human species, need to feel safe to perform any task well – from urination to sexual intimacy to birth to basic breathing and speaking. This is because two motor systems are required for optimal arousal, an emotional motor system and a voluntary motor system (Holmqvist, Santtila, Lindström, Sala, & Simberg, 2013).

The emotional motor system is adversely affected by psychological stress, and our voluntary motor system is affected by physical stress. Both, however, are required and must function together, optimally, if participation in any basic activity of daily life is desired.
This is, in part, why TATD is a requisite breath that must follow AD breath in order of mastery. First, normal sinus rhythm and safe at-rest respiratory rate must be established via AD breath via recruitment of the ventral vagus circuit. Second, in order to perform a task, even the most basic one, we must have three pressure systems functioning together as mentioned above: IAP, ITP, and SGP.

Stress that adversely affects these pressure systems must be addressed. Left untreated, sustained elevated muscle tension that is induced with physical stress may sometimes subside, however, emotional stress may cause muscle tension to persist even in absence of stress (Holmquist et al., 2013). This means vagus innervation of laryngeal muscles are very susceptible to emotional stress, which could result in a sympathetic (fight, flight, or freeze) or DVC response if there is a lack of vagal brake regulation.

The response, via the nucleus retroambiguus (NRA) and subsequent vagal pathway (Holstege & Subramanian, 2015), will adversely affect not only speech production by vocal performance but also cardiovascular health and function of the respiratory and pelvic diaphragms. The prefrontal PAG via the NRA motoneuronal pathway modulates articulation, word selection, and formation via the corticobulbar fibers sent to the face, mouth, larynx, and pharynx motoneurons (Holstege & Subramanian, 2015), which means control output for postural control and lumbopelvic and hip stability, respiratory and speech production, pain management, and improved neuroception via the messages that parasympathetic somatic motoneurons send to the gastrointestinal, cardiovascular, and respiratory system all critically depend on optimal arousal. We must move past simple AD breath to affect the pressure systems via TATD breath, with dose response, task-dependent neuromuscular re-education. TATD breath offers the neural mechanism for finding optimal arousal when the task requirements move beyond resting or inducing sleep (Figure 10).

The respiratory diaphragm has known implications in lumbopelvic and thoracic health, with greater fatigability found in those with recurrent low back pain (Janssens et al., 2013) and incontinence and low back pain found in middle-aged women with respiratory diaphragm dysfunction (Smith, Russell & Hodges, 2006). Additionally, poor lateral thorax expansion, short psoas, decreased cervical and thoracic rotation, forward head, open-mouth breathing, and forward head was found in those with muscle tension dysphonia (Tomlinson & Archer, 2015), some of which signs and symptoms overlap with low back pain occurrence, further necessitating more closely investigating the links between those with vocal disorders, swallowing issues, respiratory dysfunction, and pelvic floor or girdle issues, including lumbopelvic and/or hip pain. The respiratory diaphragm's implication in trunk stabilization, pelvic floor health, and postural control (Garner, 2016; Kolar et al., 2012; Bordoni & Zanier, 2013) provides a strictly mechanistic perspective on the importance of TATD breath, but the psychobiological consequences of seeking optimal arousal perhaps outstrip those of creating a stable yoga pose for carryover to ADL completion and recreational participation, since, in order to function in life, a person must have a healthy sense of neuroception, or perceived safety.

Requisites for TATD mastery include the orofacial and respiratory assessment, AD breath, and abdominal and anterior and posterior root locks. Additionally, normalization of subglottal pressure in the thoracic or laryngeal diaphragm is required, which can be partly facilitated through normalization of chin lock mechanics. There are three primary locks which constitute the TATD breath, as well as three secondary locks that can be implicated as synergistic state trait functions of TATD breath (Table 4).

Determination of task-dependent recruitment is dependent on the individual, her/his condition or impairment, cognitive status, psychological/emotional presentation, and of course, on the task the individual needs to perform. Task-dependent analysis requires a physical examination by a rehabilitation professional who can assess all of the locks described (6 total) (Garner, 2016), and their inter-relationship
with other musculature known to merge with the respiratory and/or pelvic diaphragm and its fascia, such as the obturator internus, psoas major, quadratus lumborum, peritoneum, and the pubococcygeus (Garner, 2016; Chaitow, 2012; Gibbons, 2001). The obliques must also be evaluated as they are implicated in rotational movement of the spine moreso than the TA (Urquhart & Hodges, 2005), though to what degree is yet to be established (Urquhart, Barker, Hodges, Story & Briggs, 2005). Finally, there is controversy and further research needed to determine task-dependent requirements for TA during basic tasks like rapid arm movements or trunk rotation, since it does not globally co-contract prior to introduction of rapid postural changes (Morris, Lay & Allison, 2013; Morris, Lay & Allison, 2012; Allison & Morris, 2008; Hodges, 2008).

Performance of TATD breath occurs withoutValsalva and via recruitment locks 2-4 (see table 4) and the remaining locks a necessary in order to voluntarily train for stability in ADL completion. The intent is not to voluntarily recruit TATD breath ad infinitum, but to train it until the involuntary response is deemed adequate, either through improved functional movement, soft tissue response, attention to task, neuroception, and/or decreased pain (since training this breath focuses on psychobiological optimal arousal through changing limbic system inputs to the PAG).

Honoring the Yerkes-Dodson Law of optimal arousal (1908) (see figure 10), the TATD breath seeks a “best fit” motor performance from both voluntary and emotional motor systems. As a result, shoulder

**Figure 10. Optimal arousal via Yerkes-Dodson Law**

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or hip lock may be needed (see Table 4) dependent on task requirement. The TATD breath is a coordinated, rather than isolated, functional strengthening breath that fully utilizes the respiratory diaphragm and increases IAP, ITP, and SGP to optimize trunk stability and vocal production, while modulating the stress response through the neural mechanism of the emotional motor system via the RNA. TATD breath, when mindfully trained for future autonomic regulation of motoneurons in both the emotional and motor systems, can be described as a kind of “zen zone,” where cortisol has also been found to be best regulated, improving cognitive and memory function (Lupien et al., 2005; Lupien, Maheu, Tu, Fiocco & Schramek, 2007), when the Yerkes-Dodson law of optimal arousal was pursued. With optimal arousal, then, cortisol levels, autonomic function of the emotional motor system, and voluntary musculoskeletal function of the TATD neural circuit is firmly established and task completion should become an effortless, virtually involuntary event.

Testing and performance of involuntary and voluntary AD and TATD strategies, which is also predictive of load transfer quality during ADL completion, is outside the scope of this chapter but can be found in Medical Therapeutic Yoga (Garner, 2016).

Precept 4: Advocate for Biopsychosocial Stability as a Primary Focus and Mobility as a Secondary Focus, With Structural Alignment of Postures Guided by Six Physiological Principles

Six evidence-based neurophysiological principles can guide yoga’s use in rehabilitation. They include kinaesthetic awareness and sensory modulation, sensitivity to pain and trauma history, respiration, stabilization, support, mobilization, and meditation (Garner, 2016). Ultimately, stability emerges as the...
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chief focus of the six physiological principles because it creates a safety net for movement and social engagement via polyvagal theory, which in turn affects RNA afferent input to motoneuronal modulation and output for all of the “ceptions”, which include:

- Neuroception (ability to detect risk)
- Proprioception (ability to detect location of the body in space) and mechanoception (joint perception)
- Interoception (ability to detect and perceive how one is feeling in the inner, introspective world)
- Exteroception (ability to detect and perceive one’s influence on the outer world through the five senses and sensory modalities such as thermoception [temperature perception] and nociception [pain perception]).

“Application of the current evidence-base of neuromechanics and common motor synergies that determine mapping of motor intention and ultimately, action, is required to establish safety of the individual (Ting, Chvatal, Safavynia & Lucas McKay, 2012; Torres-Oviedo & Ting, 2010), and for creation and prescription of safe yoga programs for wellness and/or rehabilitation” (Garner, 2016). Two primary psychobiological intentions emerge to guide yogic prescription in rehabilitation (Garner, 2016):

- Stabilization is the primary focus for use of yoga in rehabilitation. This is not limited to focus on the physical limb of the biopsychosocial model, but should address stability, psychoemotional and otherwise, through all the remaining four limbs. Creation of a safe environment for healing should be of paramount intention in an integrated clinical practice setting. Protection of the mind-body complex via should target neuromechanical and synergistic function in balance control (Ting et al., 2012, Chvatal & Ting 2013) and neuroendocrine regulation via allostasis (McEwen, Eiland, Hunter, & Miller, 2012) in order to promote safe movement and outcomes. The physical practice of yoga postures should focus on protection of proximal anatomical structures, chiefly neurovascular via the spine and spinal cord, via stabilization. Lumbopelvic stabilization can be a primary mechanism through achieving optimal intra-abdominal, intrathoracic, and subglottal pressures. Adequate intra-abdominal pressure has an unloading effect on the spine (Stokes, Gardner-Morse & Henry, 2010), while optimization of intra-thoracic and subglottal pressures have significant implications for everything from stress response, pain management, swallowing, phonation and vocal performance and preservation (Holmqvist et al., 2013; Holstege & Subramanian, 2015), which ultimately affect the development of resilience, self-efficacy, locus of control, and coping mechanisms that determine allostasis. Meanwhile, proximal to distal stabilization of the extremities (upper quarter and lower quarter) occupy a secondary focus. Exception to pursuit of proximal to distal stability must consider the neurological population, such as those with neurodegenerative diseases, TBI, or post-cerebrovascular incident, approaches such as Constraint-induced movement therapy (CIMT) support development of functional skills regardless of whether or not proximal stability is or can be achieved. If proximal stability is not available or possible, CIMT theory could dictate focus on functional task completion and motor training in a distal extremity, such as the hand or foot.

- Mobilization should follow biopsychosocial stabilization. When discussing physical practice of the postures, mobilization of joints and soft tissues occupy a tertiary focus, with use of yoga postures for myopically targeting flexibility discouraged as a reductionistic and self-limiting ob-
jective, especially given the need for taking a systems-based approach to yoga as rehabilitation to address chronic disease and pain. Exceptions to mobilization as a secondary focus include the need for addressing soft tissue restrictions or adhesions such as is used in myofascial release and scar mobilization, since they may inhibit muscular contraction and subsequent development of neurophysiological stability.

- Prescription of yoga in rehabilitation also depends on other variables which underscore that mobility is not merely a mechanical phenomenon. Those are beyond the scope of this chapter to discuss but include (Garner, 2016):
  - Joint arthrokinematics and osteokinematics
  - Fascial integrity and response
  - Neurovascular mobility and integrity
  - Open- and closed-packed joint positions
  - Manual therapy adjunct to posture and breath performance
  - Self-management and home program design
  - Sensorimotor integration (which includes energetic and psychoemotional contributions of behavioral organization)
  - Mind-body interaction and the “ceptons” discussed earlier, which addresses consciousness (citta) through the complex impact of the ego on the self and vice-versa.

**Precept 5: Provide Stability in Practice Through Two Methods**

Dynamic execution of breath and postures to foster psychobiological safety can be facilitated by two methods, internally supported postures (Asana) or passive rehabilitation methods via externally supported postures (Asana). Methods will be delivered via focus on functional carryover to ADL’s (activities of daily living), like walking or work task completion, for example, and should follow prioritization as mentioned in the previous precept: stability first, with the spine receiving priority over the extremities, and mobility second.

Intrinsic control is defined as posture or movement execution that is supported internally via a ventral vagus response and associated optimal arousal and pressure distribution through the three diaphragms (see figure 9) using the neural mechanisms of the task dependent functional breath types (A-D and TATD). A-D is used for tasks not requiring dynamic trunk and complete tri-diaphragmatic recruitment while TATD breath is used for tasks requiring strength, endurance, and stability. Intrinsic control can also be provided by any or all of the following variables to influence the stability system (psychobiological plus physical substrates of lumbopelvic, upper quarter, and lower quarter stability):

- Kinematic alignment
- Fascial force transmission
- Connective tissue responsiveness
- Visceral mobility
- Neural patterning
- Yogic Locks system (see Table 4)

Extrinsic control is provided by supports external to the body, most specifically, when the functional breath patterns are not sustainable or the variables listed above are remarkably impaired. External sup-
port can be provided for safety and clinical efficacy via blocks, bolsters, wedges, blankets, straps, ropes, walls, therapy balls, sandbags, and/or chairs. The therapist can also affect autonomic and motor system regulation by offering tactile cues and/or manual therapy to support the pose. These passive modalities should be judiciously employed, particularly in populations with chronic pain and trauma, and can include soft tissue work or other manual therapy, electrophysiological agents, durable medical equipment issue and training, and emotional motoneuron regulatory strategies in order to increase independence at home, work, and in ADL’s and promote the neurophysiological stability and/or rest.

**Precept 6: Combine Ayurvedic Methods for Analysis in Yoga Prescription**

The word translated, *Ayurveda* literally means “science or knowledge *(veda)* of life *(ayur)*. Yoga and *Ayurveda* are sister sciences in Indian Vedic studies, documented in three ancient texts *Charak Samhita*, *Sushrut Samhita*, and the *Astanga Hridaya Samhita*. They have been called the *panchakosha* *(five sheaths)*, which means the *yoga* and *Ayurveda* of the five sheaths or *koshas* (Frawley, 1999). Although assessment is beyond the scope of this chapter, early evidence does support the epigenetic effects of yoga, which creates a potential link between genomic mapping and the *Ayurvedic doshas* (Morandi, Tosto, Sartori & Roberti di Sarsina, 2010; Ghodke, Joshi & Patwardhan, 2011; Hankey, 2005; Bhushan, Kalpana & Arvind, 2005; Prasher et al., 2008; Rastogi, 2010; Sharma, Chandola, Singh & Basish, 2007). The sister sciences provide foundations which gird yoga and *Ayurveda* philosophy and are not separable without diminishing the impact and efficacy of the other. Clinical application of yoga in rehabilitation can be enhanced by recognizing the symbiotic interrelationship *Ayurveda*’s *Samkhya* philosophy and the driving theories of this chapter, optimal arousal and polyvagal theory. *Ayurvedic* philosophy aids the individual in overcoming obstructions *(kleshas)* which would cause self-destructive lifestyle choices. *Ayurveda* is the science of self-healing or teaching a person to take responsibility for his/her own health, and is ultimately a call to take care of the self and the planet through nonviolence *(ahimsa)* and duty *(dharma)*.

In clinical practice, sensitivity to a patient’s neuroceptive ability, which drive lifestyle behaviors, is critical for provision of an effective therapeutic landscape. If a patient does not feel safe, heard, and respected, therapeutic efficacy will be hindered.

Neuroception is also more complex than a binary response, that is, an individual simply perceiving a threat and it being followed by an immediate, sympathetic or parasympathetic response. Polyvagal theory dispels the notion of the historical binary (sympathetic or parasympathetic) response. Meaning, there is an additional step to perceived threat. In order for a person to perceive risk a judgement must take place about the type of risk. Is the environment or situation a safe or a threatening one? This is the question that must be answered. From there, arousal is either optimal or not. To summarize, vagal activation of the “social brain” occurs, which is influenced by limbic input to the PAG, and risk is perceived, followed by a chosen action: social engagement (VVC), “fight, flight, or freeze,” (sympathetic), or shut down (DVC).

This biomedical theory is congruent with, and can be enhanced by, inclusion of *Samkhya* philosophy. If polyvagval theory can provide us with a mechanism for intervening to foster neural plasticity, shifting our phenomenological view toward health and safety, then serious clinical implications follow. To use an example, Mary (not patient’s real name), who has a long history of pain, perceives mere breathing, or even thinking about breathing (association with previous pain experience) as a threat. Pain neuroscience tells us that Mary’s brain can perceive pain without nociceptive input. With every episodic pain experience
Mary could lose vital connecting points in the brain, in part through the PAG network and vagal tone, that could intervene to break the cyclical pain response. Hence, Mary may likely perceive more pain.

The same is true for social engagement (face-heart) connection. Another patient scenario can be used here, viewed through the Ayurvedic lens of Samkhya philosophy, or what is also known as cosmic structure (tattvas).

Using Figure 12 consider how a patient, Jamie (not patient’s real name), a person with autism who is struggling with social engagement, may respond. Jamie’s mind (manas) takes in information, the intellect (buddhi) interprets it, and the ego (ahamkara) decides what to do with it or how to “label it” based on the three pathway options shown in Figure 12. In Samkhya philosophy, explaining Jamie’s response may go as follows: Social consciousness would be in fact, unconscious (healthy or unhealthy stress response) until it is trained - and it would occur prior to manas- meaning, Jamie has deep “ruts” in the limbic region, so to speak, that would allow for amygdala “hijack” (lower brain hypervigilant or reflexive reaction instead of a well-thought out response) to occur. This response means ahamkara/ego and buddhi/intellect could be operating out of order. They are not waiting until they have all the information (manas) before acting. Jamie’s (buddhi and ahamkara) are globally perceiving situations as threats, which is an abnormal response associated with chronic HPA (hypothalamic pituitary adrenal) axis stimulation and allostatic load.

What is preferred for Jamie is a healthy stress response (optimal arousal in Figure 12) where he would:

1. Receive information (manas).
2. Process it with the intellect (buddhi), then
3. Ahamkara (ego) interjects to say “What’s going on here and where am I needed?”

From there interoceptive or exteroceptive assessment of social awareness (dependent on culture, social setting, environment, etc.) would occur, after which, if the situation is a genuine threat, then the

Figure 12. Explaining modern science with ancient philosophy: a mind map of Samkhya philosophy and polyvagal theory
sympathetic response may be appropriately chosen. However, a sympathetic response becomes a non-optimal response if it becomes the default setting, leading to changes in the brain that put the individual at increased risk for chronic disease and pain.

This explanation is a simplified, partial description of how Samkhya philosophy’s universal structure can enrich our biomedical understanding of psychoneuroendocrinology and immunomodulation. It can provide a more eloquent philosophical explanation of polyvagal theory through the language of Ayurvedic philosophy, whose synergy with quantum physics allows for a closer analysis of the nature of the observer. Additional substrates of Ayurvedic medicine that could be employed in evidence-based practice include:

- Ayurvedic massage through the study of vital (marma) points and their inter-relationship with evidence-based manual therapy.
- Therapeutic application of yoga postures and breath through the Ten Precepts
- Meditation and mindfulness
- Personalized or functional medicine and rehabilitation through study of biopsychosocial and spiritual constitutional (dosha & guna) analysis
- Nutritional recommendations via patient counseling and resource utilization based on pursuit of an evidence-based anti-inflammatory diet and lifestyle
- Aromatherapy recommendations based on known medicinal qualities
- Chromotherapy recommendations based on known medical attributes and effects
- Energy anatomy via the yogic locks system and known effects on the three diaphragms, vagal tone, and neural plasticity (PAG)
- Environmental and ergonomic analysis as related to vitality and energy (prana) and all of the limbs or domains (koshas) of the yogic biopsychosocial model.

Examination using an Ayurvedic model in biomedical healthcare has yet to be rediscovered in the “modern” medical system, despite its being touted as the oldest system of medicine. In this way, the oldest system of medicine is the last to be rediscovered. The capstone of efficacy in considering the Ayurvedic approach is that it allows for constitutional examination (CE), perhaps the original systems-based approach, versus a linear and often myopic disease-based examination (DE). See Table 5 for a comparison of CE and DE.

Finally, Ayurvedic analysis affects health literacy from the lens of instructional design. Learners learn by process, through intentional instruction and/or inference, and affecting the way they learn is widely varied, occupying a range of entry-points. Learner needs assessment could be enhanced by constitutional (doshic) examination, in that it helps determine how each of the doshas respond to, process, comprehend, assimilate, and apply information for best-fit learning.

For example, to use an oversimplification, the air/ether elements represent the wind dosha (vata). The fire (and some water) elements represent the bile dosha (pitta), and the earth/water elements represent the phlegm/mucus dosha (kapha). Vata types are creative and visionary, but may need direction in manifesting knowledge in order to take concrete action. Pitta types are more likely to take the proverbial “bull by the horns” and self-direct, even to a fault, and are fully capable of reading the evidence, synthesizing it, and applying it independently. Kapha types, by contrast, need lots of accountability structure and supervision, in order to move beyond their belief that the “status quo” is just fine.
Ayurvedic medicine can help bridge a gap between organizational objectives and what the individual actually needs to thrive. In rehabilitation, this means learning how to meet a patient where they are, with appropriate amounts of empowerment, education, and motivation, so that she/he can be an invested partner in a system that proactively encourages self-direction of his/her healthcare. It also allows the clinician to ask the questions:

- What gap in knowledge must be bridged (organizational objectives)?
- What do we need to learn (in our field)?
- What will help the person or industry learn? (training)
- What will motivate the person or industry? (individual needs)

These are only some of the guiding tenets of modern Ayurveda application that can provide biological plausibility for improving patient education, outcomes, and inter professional relationship. Philosophies

### Table 5. Constitutional versus disease-based examination

<table>
<thead>
<tr>
<th>Examination Type</th>
<th>Constitutional Examination (CE)</th>
<th>Disease Examination (DE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>Wellness-prevention seeking, seeks a three-dimensional view in a systems-based biopsychosocial assessment</td>
<td>Diagnosis-seeking, systems assessment occurs in silos that separate the mind-body complex for a biomedical single-dimension view</td>
</tr>
<tr>
<td>Purpose</td>
<td>Considers every facet of a person’s being and not just their disease, if in fact a disease has manifested itself.</td>
<td>Allows for diagnoses of disease states, not potential disease states.</td>
</tr>
<tr>
<td>Outcome</td>
<td>Allows for identification of pre-disease states and precursors to impairment</td>
<td>Adept at handling acute medical emergencies and crises</td>
</tr>
<tr>
<td>Indications for Use</td>
<td>Recognize that both CE and DE will be required when dealing with disease in its full manifested state – that is recurring or chronic. For prevention-based practice and functional medicine and rehabilitation to optimize quality of life and prevent injuries and disease.</td>
<td>Discern by differential diagnosis if a medical condition or state requires immediate intervention, as in a medical emergency or crisis. In this case, CE would be best postponed until the individual is medically stable and in an out patient or post-rehabilitative state.</td>
</tr>
</tbody>
</table>
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like Ayurveda can provide a unifying theory for our global healthcare system, in dire need of reform, and provides hope by changing the way we approach healthcare – by empowering the individual for action.

**Precept 7**

Include evidence-based sound, music, and voice analysis as therapy to affect allostatic load, systemic inflammation, neural plasticity, and/or ventral/myelinated vagus nerve stimulation via pre-frontal cortex, motor cortex, cranial nerves (lower) (Bella et al., 2009; Bengtsson et al., 2009; Brandes et al., 2009; Brandes, 2008; Conway, Pisoni, & Kronenberger, 2009; Levitan, 2007; Murrock & Higgins, 2009; Bernard, 2004; Nilsson, 2008; Thaut, 2010; Thaut et al., 2009), and cardiorespiratory neural mechanisms, which also exert influence on pressure systems that affect laryngeal/thoracic, respiratory, and pelvic diaphragms.

Orofacial function reveals a face-heart connection and language that can be addressed through yoga informed by rehabilitative science to attend to psychobiological health. Pathways for efficacy are centered around the psychobiological and neurophysiological mechanisms of polyvagal theory discussed earlier in this chapter. Delivery modalities can include sound, music, and voice analysis and therapy that affect the yogic locks system and neuroendocrine health (Garner 2016), briefly discussed in the previous precepts.

**Precept 8: Teach non-Weight-Bearing Headstands (sirsasana) and Non-Cervical-Weight Bearing Shoulder Stands (Salamba sarvangasana), Emphasizing Protection of Vulnerable Joints That Include the Small Joints of the Hands, Feet, and the Spine and Pelvis (Which Includes the Hip)**

The chief impetus for this precept is giving the spine priority in practice, including the nervous system, coupled with the epidemic and pandemic of comorbidities that typical patients in rehabilitation generally experience, which would make axial loading and forced full cervical flexion with (likely) anterior vertebral body shear under loaded conditions contraindicated.

The wide range of motion available in the cervical spine, more than in any other part of the spine, means that phylogenetically, stability was sacrificed to allow for mobility. The vertebrae of the cervical spine must protect “delicate neural structures” (Panjabi et al., 1998) while affording a large neutral zone, with C1 and C2 providing up to 75% of the total 50% increase in neutral zone as compared to the lower cervical spine (Panjabi et al., 1998). Maximum load capacity is drastically reduced in the cervical spine, where absence ofbony and capsular stability require the cervical musculature provide up to 80% of cervical stability (Goel, Clark, Gallaes, & Liu, 1988; Panjabi et al., 1998), and this is assuming optimal cervical spine alignment with no loss of the cervical lordosis or mal-adaptations such as anterior vertebral body shearing. Critical load capacity would diminish then, being inversely proportional to internal shear force or other flexion moments, for example, in the average population who has forward head (anterior cervical vertebral shear) and poor postural alignment (Garner, 2016). Due to the lack of intervertebral disc between C1-C2, any compressive or axial load would disperse through C1-C2 and the remaining facet joints, which means any degeneration, occurring as a natural result of aging (Brinjikji et al., 2015), would place the discs at risk of end plate failure. Comorbidities such as postural mal-alignment or poor postural awareness and proprioception can place the cervical spine at higher risk for injuries such as disc compression and nerve root compression with or without extrusion (Garner, 2016).
The high prevalence of back pain, over 84%, (Freburger et al., 2009) and neck pain, exceeding 30% (Cohen, 2015) in the general population, also cited as a major international public health problem (Fejer, Kyvik, & Hartvigsen, 2006), precludes most populations from practicing complete headstand or shoulder stand. However, after a physical examination and clearance by a physical therapist and/or neurologist or orthopaedist, the postures can be practiced with therapeutic modifications (Garner, 2016).

Performing traditional axial and cervical weight-bearing yoga inversions negates the beneficial opportunity for improving upper quarter and torso strength and stability that non-axial- and cervical-loading inversions provide. For this reason, modified and full shoulderstands should and can be taught with mindful preservation of the cervical lordosis without reversal and concomitant cervical loading. Headstands likewise can be taught without axial loading in order to avoid the buckling effect of the cervical spine, unknown effects of long-term loading of delicate cervical structures, and excessive compression forces on the temporomandibular joint, while at the same time maximizing potential for strengthening of the locks system (see Table 4).

When inversions are absolutely contraindicated or cannot be performed safely, semi-inversions, serve as a suitable substitution (Garner, 2016). They can introduce spinal unloading in a safer, gravity-minimized position, instead of in full inversions, where the pose is still gravity dependent and higher risk.

Semi-inversions postures also serve as prudent pre-requisites to spinal loading postures. It is outside the scope of this chapter to discuss or instruct semi-inversions or inversions, however, postures can include such Asana as threading-the-needle, legs-up-the-wall, downward facing dog (DFD) and all of its variations, transition & preparation for headstand, which include caterpillar, stork, and dolphin dive (Garner, 2016).

Finally, protection of vulnerable structures like the small joints of the hands and feet, and the structures whose integrity depend on stability, the spine and pelvis, should be paramount in posture prescription. Hip dysplasia, morphological structure of the pelvis, and spinal degeneration are common conditions that can be developmental or acquired. These conditions do not necessarily cause pain, so proper evaluation and screening must occur prior to participation in yoga so that any unidentified conditions do not contribute unnecessarily to a pathological or painful state. For example, a condition of rheumatoid arthritis would contraindicate postures that stress commonly involved joints, like the hands, wrists, feet, and ankles. Ehlers-Danlos syndrome, or for someone less involved, someone with hip dysplasia, would require specialized posture prescription, which would include a strong emphasis on the precepts which involve stability and joint and soft tissue protection. Further, the morphological structure of the hip would need to be screened, ideally through comprehensive orthopaedic physical therapy examination, to discern which osteokinematic and arthrokinematic movements are impaired or absent, including prescriptive modifications for ranges of motion that are identified as high risk. These are just two examples of many which make this precept critically relevant for using yoga in rehabilitation. More resources on safeguarding the spine, pelvis, and small joints of the hands and feet can be found in Medical Therapeutic Yoga (Garner, 2016).

Precept 9: Nurture Non-Dogmatic Yoga Practice in Rehabilitation

Why do people come to yoga? And, if intentions are only to heal a hurt, is that yoga? The short answer is, yes. People come to yoga for many reasons, and no matter their entry-point, the care provided through use of yoga should be person-centered, compassionate, and culturally sensitive. If a patient comes to
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yoga for the physical and not the spiritual that does not mean it is not yoga. As professionals using yoga for patient care, it is not our job to judge a person’s intentions. It is our duty (*dharma*) to guide a patient toward best-evidence mindful practices that are nurturing and sustainable for the self and the universe at large.

Yoga philosophy and practice in rehabilitation science moves beyond religion and politics, especially when using the partnership model (see figure 3) to transform healthcare culture; and, it can serve any patient population if applied through the lens of evidence-based practice. Yoga can be non-dogmatic, non-discriminating, and welcoming to all disciplines of yoga and types of individuals, extending respect and inclusiveness to all spiritual belief systems and rehabilitation professions. The often physical nature of today’s yoga practice has not diminished the spiritual potential of yoga to heal on a psychobiological level. Yoga is a way to deepen one’s spirituality and faith in one’s belief system.

From the late 20th century to today, what existed as brands or lineages of yoga must be reconsidered, particularly if history is studied and heeded. Otherwise, we may disenfranchise yoga’s inclusion in healthcare for another generation. Yoga, as a whole, is more important than one “brand” or type of yoga, since a single prescription cannot be used as a “recipe” or defined as a singular methodology or path for pursuit of yoga (Garner, 2016).

In the 21st century the irrelevance of dogmatic lineages is even more poignant when faced with epidemic proportions of chronic pain and disease internationally (WHO, 2005), which provides the impetus for using an accessible, holistic, biopsychosocial approach for integrative pain management (Garner, 2016; Pergolizzi et al., 2013).

The biomedical model is also in need of evolution. By current practice standards, “patient satisfaction, patient outcomes, patient-provider relationship, chronic disease and injury prevention, and public health education suffer. Occupational hazards are also high for healthcare providers, including therapist disability, compassion fatigue, and high rates of suicide” (Garner 2016, Iliceto et al., 2013, Fiabane, Giorgi, Musian, Sguazzin, & Argentero, 2012; Devi, 2011; Wallace, Lemaire & Ghali, 2009). We, as a collective healthcare community, have the opportunity to move past dogma, corporate co-opting of yoga, and the historical patriarchal domination of both yoga and medicine.

**Precept 10: Teach the Practitioner and Patient to Seek the Self Pursuant to One’s Duty/Mission (*Dharma*) as a Primary Pursuit in Rehabilitation Care**

Our main goal in rehabilitative care is to help patients improve their quality of life and functioning in a sustainable way. The main intention in yoga is to foster radical self-care and a sustainable way of life that promotes cosmic unity and intrinsic balance. From a physiologically standpoint, this is easy to envision, but it may be more difficult to imagine the intangible aspects of what contribute a high quality of life, particularly through the lens of the remaining variables in the biopsychosocial model.

First, quality of life is dictated by two variables, connection and consciousness. Having healthy relationship depends on being aware of one’s self and impact on others. Connection means feeling significant, included, and part of something that is larger than the self, which could be described as a basic human need.

In science, this means looking beyond the double blinded, randomized control trial (RCT) and valuing the individual story and experience. Experiential evidence and practice are valued in yoga and should also be given weight in evidence-based medicine. A clinician’s 25-year experience in treating chronic
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pain, for example, should carry weight and value in considering how best to address a particular diagnosis or condition in a patient. The RCT should not necessarily dominate the top-tier of a research triangle as much as it should be valued alongside and in shoulder-to-shoulder partnership with the humble case study. They, and all evidence levels between them, can be of equal value in pursuing the use of best-practice yoga in rehabilitation.

In clinical practice, the implication is to look at each person as a whole, individual, rather than a broken diagnosis. One of the first questions on a medical intake form should query the patient about goals for care. What is the reason for his/her seeking healthcare? How does this tie in with life goals, or what she/he considers to be their mission or life’s purpose (dharma)?

Clinicians must consider these questions if we are to fulfill a primary role as a healthcare provider - that of patient advocate. Perhaps our highest calling is to support and campaign for the patient’s best outcome and highest quality of life, which means reacquainting medicine with Hippocrates’ charge, “To find out what sort of person has a disease, rather than what sort of disease has a person.” We must re-introduce facets of social, emotional, spiritual, and occupational patient needs back into the medical process in order to truly embrace and be effective at biopsychosocial care. The precepts in this chapter, and elaborated on in Medical Therapeutic Yoga (Garner, 2016), provide an evidence-based foundation for incorporation of yoga into healthcare and to contribute to partnership and scholarship in healthcare and yoga through (Garner, 2016):

- Fostering safety and clinical efficacy in rehabilitation and injury prevention,
- Offering the potential for cultivation of mindfulness in medical practice and daily living,
- Encouraging active patient participation and encourages “person-provider” relationship over “patient-provider” relationship,
- Embodying slow medicine,
- Fostering interprofessional collaboration,
- Adopting BPS model of assessment,
- Provision of interdisciplinary educational competencies for graduate and postgraduate curriculum (IOM, 2013; Pergolizzi et al., 2013) that honor yoga’s origins and complexity.
- Facilitating interdisciplinary relationship and subsequent creativity in rehabilitation through a biopsychosocial model using a partnership model (Garner, 2014).
- Broadening yoga’s reach in medicine for physiological stability in the individual rather than limiting yoga to only flexibility, mobility, mindfulness, or relaxation training.
- Embodying egalitarian practice and adoption of traditionally feminine characteristics known to improve patient outcome and satisfaction.

Yoga’s historical therapeutic roots can be intelligently and sensitively cultivated in order to emerge with an evolved way to implement yoga’s use into healthcare, which includes rehabilitation and all fields of medicine. This chapter offers the working template for such an evolution.

Yoga, when practiced through the lens of evidence-based medicine, offers a low-cost, low-tech methodology and phenomenology that could stand to greatly improve our management of chronic pain and non-communicable and lifestyle disease processes. What’s more, through the Ten Precepts, it offers both a qualitative and quantitative method for injury and disease prevention and improving efficacy of existing yogic practices. It is also important to realize that scientific research will continue to evolve
the therapeutic strategies utilized in healthcare, which includes the invention of new approaches on an ongoing basis. This marked evolution is evidence of yoga’s living medicine, and the willingness of biomedical medicine to embrace both its art and scientific potential underscores yoga’s accessibility and adaptability for all populations.

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**KEY TERMS AND DEFINITIONS**

**Abdomino-Diaphragmatic Breath:** A controlled method of breathing in which the diaphragm is used for inspiration and the abdominal muscles for expiration. This technique improves exertional dyspnea, esp. in patients with chronic pulmonary disease. Synonym: diaphragmatic breathing.

**Allostatic Load:** Allostatic load is “the wear and tear on the body” which accumulates as an individual is exposed to repeated or chronic stress. It represents the physiological consequences of chronic exposure to heightened neural or neuroendocrine changes which arise from repeated or chronic stress.

**Biopsychosocial Model:** The biopsychosocial model is a broad view that attributes disease outcome to the intricate, variable interaction of biological factors (e.g., genetic, biochemical), psychological factors (e.g., mood, personality, behavior.), and social factors (e.g., cultural, familial, socioeconomic, medical.)

**Chronic Pain:** Chronic pain is often defined by an arbitrary interval from the time of onset. chronic pain, involving no arbitrarily fixed duration, is “pain that extends beyond the expected period of healing”.

**Mouth Breathing:** Mouth breathing (also termed open-mouth breathing or a mouth breathing habit) is breathing through the mouth rather than the nose.

**Pelvic Girdle Pain:** Pelvic girdle pain (PGP) is the umbrella term for all pelvic pain, including pubic pain which was previously called symphysis pubis dysfunction (SPD).
Postural Stability: In the case of an individual standing quietly upright, the limit of stability is defined as the amount of postural sway at which balance is lost and corrective action is required.

Thoraco-Diaphragmatic Breath: Diaphragmatic rib cage breathing is harder to learn, and it can stray into inefficient, anxiety-promoting upper-chest breathing if done incorrectly. But if performed properly, it is calming and much more powerful for strengthening the diaphragm, deepening the inhalation, stretching the lungs, and more effectively aerating all parts of the lungs. It can even improve your backbends.

Ventral Myelinated Vagus Nerve: The ventral branch of the vagus originates in the nucleus ambiguus and is myelinated to provide more control and speed in responding. This branch is also known as the “smart vagus” because it is associated with the regulation of sympathetic “fight or flight” behaviors in the service of social affiliative behaviors. These behaviors include social communication and self-soothing and calming.

Yerkes-Dodson Law: The Yerkes–Dodson law is an empirical relationship between arousal and performance, originally developed by psychologists Robert M. Yerkes and John Dillingham Dodson in 1908. The law states that performance increases with physiological or mental arousal, but only up to a point. When levels of arousal become too high, performance decreases.