Session Overview
When fitting patients for a seating system close attention is paid to posture, function and pressure distribution. However, little consideration is given to the impact that postural changes and structural support systems have on respiratory function and there is little research directly related to wheelchair seating. There is a newfound interest in understanding this relationship and how it impacts Seating and Positioning recommendations. Specifically, this course will increase the cross functional relationship between the cardiopulmonary system and postural alignment and how they impact the design of the wheelchair seating system. This awareness will help the seating and mobility specialist to maximize postural alignment without compromising breathing mechanics. The mechanics of breathing are directly impacted by the skeletal alignment of the spinal column and rib cage and freedom of movement of the diaphragm, and are most directly impacted by lack of postural control and at times attempts to “over control” by custom molded shapes and/or external postural supports such as lateral thoracic pads that impact free rib cage expansion. This presentation will focus on objective measures that can be used during wheelchair assessment to determine the effect the seating and positioning intervention has on the patient’s cardiopulmonary status. Evidenced based research such as studies from Mary Massery, PT, PhD confirm the need to create client solutions that “generate, regulate and maintain trunk pressures for optimal respiratory mechanics and postural alignment.” [1] Other research will be shared that support this treatment approach. In addition, the effects of the diagnosis on respiratory function, seating systems and angles of positioning will be discussed.

Supportive Research of the Impact of Structural Integrity on Respiration
The APTA Guide to Physical Therapy Practice identified the primary systems involved in postural control and movement as Musculoskeletal, Neuromuscular, Cardiovascular/Pulmonary, Integumentary and Internal Organs, specifically gastrointestinal. [1] Internal organs that generate and/or use positive pressure are the Pulmonary System, Heart/Circulation, Gastrointestinal tract and the Lymphatic System. The integrity of the Skeletal system is imperative for posture and respiration. The ribs were designed for mobility at the expense of stability. As far as the relationship to wheelchair seating posture, subtle changes in seating can affect how the ribcage moves. In fact posterior stability of the spine provides the stability for the anterior rib case to expand and positive pressures have all to do with providing trunk and postural stability thus allowing freedom of movement of not only the rib cage but the individual’s functional movement. Mary Massery, uses the “Soda-pop Can” Model of Postural Support. The concept is based on what makes a thin aluminum soda-pop can “strong”? She clearly relates this to postural control and respiration. [2] Additionally, Hodges and Gandevia found that respiration and posture are linked. [3] Hodges, 2007 suggested multiple relationships between the trunk, pelvic floor, diaphragm and shoulder muscles and their role in postural stability and tasks.[4] We will look at this in closer detail in the session.

Respiratory Assessment and Wheelchair Positioning Strategies
The clinician has access to a number of tools to assess diaphragm function in patients with neuromuscular disorders. A detailed history and physical exam that focuses on inspection and palpation of the respiratory muscles and motion of the chest wall are an indication of respiratory muscle weakness. Increased lumbar lordosis increased lung volumes for patients seated in their wheelchairs. [5] Shifting the pelvis toward an anterior pelvic tilt opens the anterior chest wall and tends to facilitate more upper chest breathing while a posterior tilt where the pelvis rolls backward facilitates more diaphragmatic breathing. Positioning of the upper extremities and head and neck will also affect respiration and breathing as well.
Little research exists that specifically evaluates the effect of Tilt, Recline or Tilt and Recline on respiratory function. Most often our recommendations on postural angles are based on pressure and functional activity but not specifically on respiration. One such study does refer to forced expiratory flow rates that are reduced in patients with neuromuscular weakness. The fall in VC between the **upright and supine positions** has been used to assess diaphragm weakness and is a more sensitive indicator of respiratory muscle weakness than upright measures of VC and TLC. [6] Further exploration in this area seems warranted.

Some investigation in the use of binders for postural support shows an effect on respiration. For instance, Frownfelter found that for individuals without pathology both a Thoracolumbar-sacral Orthosis (TLSO) with and without abdominal cut-out showed decreases in Forced Vital Capacity (FVC) and forced expiratory volumes, but those with an open TLSO had less decrease than those with the closed TLSO. The clinical relevance is patient complaint of dyspnea when a TLSO is needed to stabilize the spine for various pathologies. This can cause poor compliance issues, and an abdominal cut-out may provide a positive compromise. [7]

Additional research on Postural Strategies, Spinal Asymmetry, Wheelchair Seating Interventions and Respiratory assessment methods will be discussed during the session suggesting that an individualized comprehensive assessment for wheelchair seating and positioning have a respiratory assessment component in order to ensure a successful outcome for our clients.

**References**


**Additional References**

2. Pederson, Jessica, OTR/L, ATP, Sparacio, OTR/L, ATP, ABDA, Focusing on Breathing in Adults with Cerebral Palsy, 27th International Seating Symposium, March 3-5, 2010

**Session Objectives**

- The Participant will be able to describe the pathophysiology and associated clinical symptoms for diagnoses which involve neurocognitive changes and how they affect treatment planning and equipment prescription.
- The Participant will be able to describe at least 3 findings of Evidenced Based Practice Research as to the cognitive/behavioral changes associated with neurologic diagnoses.
- The Participant will be able to describe two implications of how proper wheelchair seating and positioning impacts the utilization of assistive technology devices.
- The Participant will be able to identify three key measures or strategies that can be used to evaluate an individual’s ability to operate drive controls and electronic features of the wheelchair.
- The Participant will be able to identify at least three strategies or interventions in order to establish a good match between the individual and the equipment being prescribed.

**Speaker Bio**

Lois Brown, MPT, ATP/SMS is a physical therapist with 20 years experience, and the Rehab Clinical Education Specialist for Invacare. Her professional experience includes adult and adolescent rehab and wheeled seating and mobility in several wheelchair clinics in Philadelphia, PA. Lois also has extensive experience in working with clients with Brain Injuries, other Neuromuscular Diseases, Developmental Disabilities and Pressure Management. Lois has presented in national and international conferences on Wheeled Seating and Mobility and Assistive Technology, including the International Seating Symposium, European Seating Symposium, and RESNA conference. Lois has been published in a variety of Rehab Publications and is considered an expert in her field.