

Physical Therapy Clinical Management Recommendations for Children with Cerebral Palsy - Spastic Diplegia: Achieving Functional Mobility Outcomes

Margaret E. O'Neil, PhD, PT, MPH, Maria A. Fragala-Pinkham, MS, PT, Sarah L. Westcott, PhD, PT, Karen Martin, PT, M.Ed, Lisa A. Chiarello, PhD, PT, PCS, Joanne Valvano, PhD, PT, Rachel Unanue Rose, PhD, PT, PCS

Drexel University (M.E.O'N., L.A.C.), Philadelphia, PA; Franciscan Hospital for Children (M.A.F-P.), Boston, MA; University of Puget Sound (S.L.W.), Tacoma, WA; Federal Way Public Schools (K.M.), Federal Way, WA; University of Colorado at Denver & Health Sciences Center, (J.V.) Denver, CO; University of Alabama (R.U.R.), Birmingham, AL

The purpose of this special report is to present recommendations for the clinical management of children with cerebral palsy, spastic diplegia when increased functional mobility is the identified outcome. These recommendations provide a framework that allows physical therapists to increase their accountability and promote effective interventions for improved patient outcomes. The key components of this special report on clinical management are: a) the Major Recommendations that provide the background and evidence for clinical management; b) a flow chart to assist in clinical decision-making; and c) a Table of Tests and Measures for information on useful tools in the management of children with spastic diplegia. These recommendations are suggestions for clinical management, not an all-inclusive document on physical therapy for children with cerebral palsy. These recommendations may help therapists develop systematic approaches to service delivery and documentation. (*Pediatr Phys Ther* 2006;18:49–72) **Key Words:** *adolescent, child, cerebral palsy, physical therapy/procedures, practice guidelines*

INTRODUCTION

Clinical Management

Clinical management in physical therapy provides a framework to enhance the organizational capacity of services; integrate evidence for best-practice; and improve outcomes. Recommendations for clinical management can be an effective method from which guidelines, pathways, and algorithms can be developed to improve quality of care in a health care

environment that is challenged by diminishing resources and the call for increased accountability.¹ Clinical management includes recommendations for the care of patients/clients with specific diagnoses or conditions. Clinical management is important in and across all service delivery settings including hospital, clinic, and community environments. Because a majority of pediatric physical therapy is provided in community-based settings, it is important that pediatric physical therapy clinical management includes communication across service delivery settings to ensure quality patient care and maximize outcomes.

An important function of clinical management is to apply evidence from the clinical and scientific literature to help the practitioner determine the appropriateness of selected interventions and choices in patient management.¹

Physical Therapy Clinical Management Recommendations for Children with Cerebral Palsy – Spastic Diplegia (PTCMR-SD), addresses a specific outcome, *increased functional mobility*, for children and youth with spastic diplegia.

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Address correspondence to: Margaret E. O'Neil, PhD, PT, MPH, Drexel
University, Programs in Rehabilitation Sciences, 245 N. 15th Street, Mail
Stop 502, Philadelphia, PA 19130; Email: moneil@drexel.edu

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Why Develop Task Specific Clinical Management Recommendations For Children With Cerebral Palsy?

Cerebral palsy is a neurodevelopmental condition that begins in infancy or early childhood and is present through the lifespan.² Cerebral palsy is the most frequently reported diagnosis for children who receive physical therapy.³ Spastic cerebral palsy is most common and includes diplegia and hemiplegia. Spastic diplegia is characterized by increased stiffness in the lower extremities, minimal involvement in the upper extremities and trunk weakness.⁴ Children with cerebral palsy most often receive physical therapy in the home, school or community.⁵ Because large numbers of children with cerebral palsy receive physical therapy services and children with spastic diplegia often receive services in isolated community settings, recommendations for clinical management may help therapists develop a systematic plan of care for children with spastic diplegia.

PTCMR-SD were developed to provide structure to physical therapy services for children and adolescents with spastic diplegia across all settings (including home, school, medical setting, community) and in all service delivery models (community-based, home-based, clinic-based). These recommendations should assist the new physical therapist (PT), the experienced PT and the PT who is not a specialist in pediatrics. Potentially, more experienced pediatric therapists could use these recommendations as a quick checklist or resource to confirm or refine their clinical management of children with spastic diplegia. Further, the recommendations may be helpful to PTs that are developing clinical competence focusing on examination, evaluation, anticipated goals, and interventions for children and adolescents with spastic diplegia.

How Were These Clinical Management Recommendations Developed?

In 1999 the Section on Pediatrics, appointed a Task Force to develop practice recommendations for clinical

management for children with cerebral palsy, spastic diplegia. These recommendations were developed based on several resources and theoretical concepts. General information was gathered at focus groups to identify practice patterns during the Section on Pediatrics Research Roundtable Meetings at the American Physical Therapy Association's Combined Sections Meetings in 1999 and 2000.⁶ The Task Force then developed recommendations using data from these meetings, available evidence on best practice, and clinical experience.⁷ This document on clinical management is organized into three specific sections: 1) a narrative with recommendations and supporting references, 2) a general flow chart illustrating considerations in clinical decision-making and management and 3) a Table of Tests and Measures used in clinical management.

What Models Were Used To Develop This Framework For Clinical Management?

The Guide to Physical Therapist Practice⁸ (Guide) and the World Health Organization (WHO) International Classification of Function (ICF)⁹ were used to provide a structural framework to the PTCMR-SD and to identify components of patient care. Brief definitions from the Guide and ICF are provided in Table 1 and Table 2. Therapists are referred to both documents for detailed information.

Practice Pattern 5C in the Guide: Impaired motor function and sensory integrity associated with non-progressive disorders of the central nervous system – congenital origin or acquired in infancy or childhood⁸ provided the structure for the intervention strategies included in these recommendations for clinical management. The following concepts also were integrated into these recommendations:

- functional outcomes
- the principles of family-centered care^{10,11}
- applications of task-oriented approaches to intervention¹²⁻¹⁴
- dynamic systems theory of motor learning and control.¹⁵⁻¹⁷

TABLE 1

Definitions of Terms used in the Guide to Physical Therapist Practice⁸

Examination	A comprehensive screening and process of specific testing to determine a diagnosis or the need for referral to other health practitioners. Three components of the examination are: the patient/client history; systems review; and tests and measures.
Evaluation and PT Diagnosis	A dynamic process in which the physical therapist evaluates and synthesizes the examination findings to help determine prognosis and plan of care.
Prognosis and Plan of Care	Identification of the optimal improvement level expected through intervention and the time needed to reach this level. Plan of care includes definition of intensity of therapy (frequency and duration). This clinical management framework includes identification of preventive approaches to plans of care for children with cerebral palsy.
Intervention	The interaction between the therapist and the patient and other members of the patient's health team as appropriate. Intervention may occur on three levels: communication, coordination, and documentation; patient related instruction; and procedural intervention.
Outcomes and Reexaminations	The results of physical therapy intervention during an episode of care. Outcomes include anticipated goals and expected outcomes as identified by the physical therapist and child/family. Reexaminations are conducted during intervention to determine change in patient status and to revise the intervention plan as indicated.
Episode of Care	A defined number or identified range of number of visits for physical therapy services provided by a physical therapist in an unbroken sequence and related to interventions for a specific condition/problem or related to a patient, family member or other provider's request. Episodes of care may vary on level of intensity (frequency or duration).

TABLE 2

The WHO Enablement Model (ICF): 9 Definitions of the levels of ability considered in the context of the patient/client social and physical environment

Body Structure/Function	The limitations in anatomical structure and physiological function of the body (similar to the pathophysiology and impairment levels of the NCMRR Disablement Model)
Activities	The execution of a task or action by an individual (similar to the functional limitation level of the NCMRR Disablement Model)
Participation	Involvement in a life situation (similar to the disability/societal limitation levels of the NCMRR Disablement Model)

Components Of The Clinical Management Recommendations

The three components include: 1) Major Recommendations (with references); 2) a Physical Therapy Clinical Management Decision Making Flow Chart (Figure 1), and the Appendix A: a Table of Tests and Measures.

It is important to note that these are recommendations or suggestions for clinical management. This is not an all-inclusive document for providing physical therapy to children with cerebral palsy. These recommendations were developed based on a specific task for which a physical therapist may be providing service. The specific task is functional mobility, which may take different forms depending on the child's abilities, goals, and age. A task-driven model was chosen to provide more functional relevance to these recommendations for clinical management.

Future Work

We suggest that these recommendations for clinical management be revised periodically to reflect the current literature and new trends in medical and rehabilitation management of children with spastic diplegia. In the future, the references could be coded according to the strength of scientific evidence as in Sackett's Levels of Evidence.^{18,19} If references are coded, this document could be used to identify research initiatives that are needed in clinical management of children with spastic diplegia. Additionally this document could provide the foundation for clinical guidelines or pathways to im-

prove outcomes and lead to more effective and efficient care for children with spastic diplegia.

Conclusion

Again we would like to caution users of these recommendations for physical therapy clinical management that this document is a guide and not all-inclusive for providing physical therapy services to children with cerebral palsy. We believe these recommendations will help therapists develop systematic approaches to service delivery and documentation that will contribute to evidence-based practice and enhanced outcomes. This document should help therapists become even more reflective practitioners and promote use of the most effective interventions.

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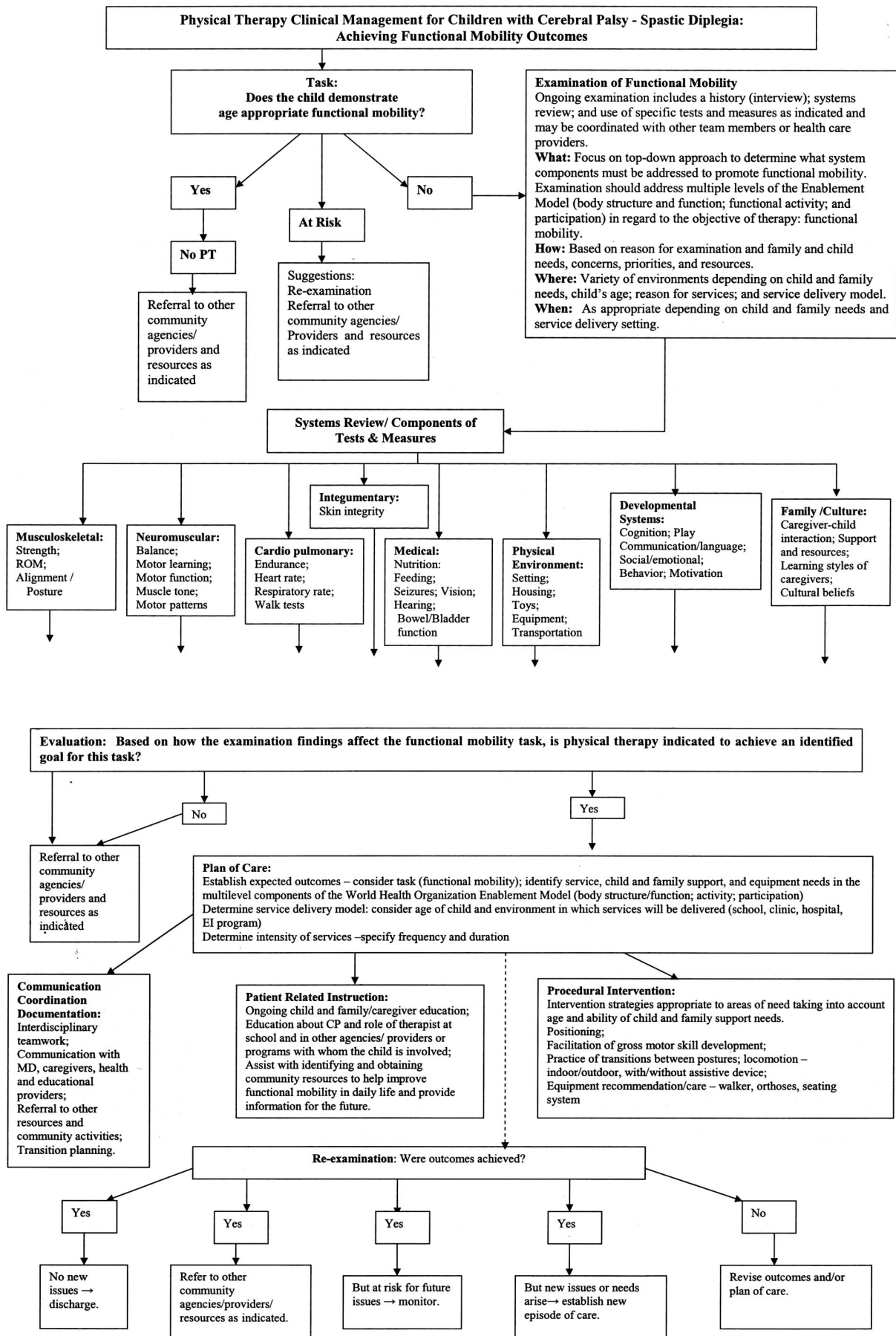


Fig. 1.

EXAMINATION

Examinations are conducted to identify the specific functional mobility strengths and needs of the child and family using a functional outcomes or top down approach. The method used to conduct an examination is determined by the purpose of the examination, the child's functional ability, the family and child needs, the child's age, and the service delivery setting.²⁰

Where? Examinations occur in a variety of environments depending on the child's age, family preference, the reason for examination, type of service delivery model, and agency/program in which the child is enrolled.

General Considerations for All Ages

- Infants, children and youth may receive services in a variety of settings (school, hospital, an outpatient facility or community agency). Inpatient hospital services are often indicated after surgery while outpatient, home health or other community settings may be appropriate for specific episodes of care and for older children.

Special Considerations for Infants and Toddlers (Birth to Three Years)

- Examinations may be initiated in the hospital setting (e.g. Neonatal Intensive Care Unit (NICU)) for infants born prematurely and/or with low birth weight. Infants born premature or with low birth weight are at risk for developing spastic diplegia.²¹

- Infants with or at risk for spastic diplegia may be examined in an early intervention community setting as defined under the Individuals with Disabilities Education Act (IDEA), Part C. Examinations take place in "natural environments", which are often in the child's home but could also include childcare settings or other community sites.²²

Special Considerations for Preschoolers (Three to Five Years)

- Under IDEA, Part B physical therapy examinations usually take place in the community setting, preschool, or childcare setting. Sometimes examinations take place in the home if home-based services are warranted.²²

Special Considerations for Children and Youth (Six to 21 Years)

- Under IDEA, Part B physical therapy examinations usually take place in the school setting, which may include the classroom, school hallway, gymnasium, therapy room, school cafeteria, or outdoors on school grounds.²²

When?

General Considerations for All Ages

Examinations are conducted at convenient times for infants, children, and youth; their families; and school and health personnel. An examination is performed initially when the infant, child or youth is referred for services. In the hospital setting, the schedule of reexaminations is dependent on the child's condition and medical status. In outpatient clinics, reexaminations often occur in accordance with hospital, clinic, and insurance policies.

Special Considerations for Infants and Toddlers (Birth to Three Years)

- In early intervention settings, according to federal

law (IDEA Part C) and state laws, reexaminations may be done at any time by parent request but are often conducted at six-month intervals in addition to a yearly full re-examination.

Special Considerations for Children and Youth (Three to 21 Years)

- In preschool and school settings, according to federal law (IDEA Part B) and state laws, formal reexaminations may be conducted annually but are required every three years. Written family permission is required for formal examinations in the school setting.

What?

Examination is a comprehensive process with three components, including: 1) **Patient history** - interviewing or chart review to identify child's past and current functional and health needs; 2) **Systems review** - brief screening to identify functional mobility needs, which is the specific purpose of this task driven model and 3) **Tests and measures** - gathering specific data to establish plan of care.⁸

How?

Patient History. Histories are performed through a structured family interview and systematic medical or educational chart review.

General Considerations for All Ages

- Information about the child's mobility skills and health status is obtained through a systematic child and family interview and chart review. Important medical information includes past surgeries, spasticity management interventions, medications, and review of hip and spine x-rays and gait studies. Important social/developmental/educational information includes family and child's experiences and expectations and child's placement and participation in community or school settings.

Special Considerations for Infants and Preschoolers (Birth to Five Years)

- Family interview includes gathering information about an infant or young child's birth history including prenatal and perinatal problems such as prematurity, low birth weight, periventricular leukomalacia, and intraventricular hemorrhage. Infants and children may not be formally diagnosed with spastic diplegia until one to two years of age. Therefore, it is important to document risk factors commonly associated with spastic diplegia to help with differential diagnosis.²³ According to IDEA Part C, families are asked to participate in a voluntary family assessment often conducted by interview.

Special Considerations for Children and Youth (Six to 21 Years)

- Youth, family, and teacher interviews focus on functional skills needed for school, home and community participation and transition to adulthood. Interviews may be guided by specific concerns of the adolescent/young adult.

Systems Review. The purpose of the systems review for PTCMR-SD is to identify the child's functional mobility strengths and needs. Multiple systems are screened to determine areas that require further testing. The systems identified in the Guide (Musculoskeletal, Neuromuscular,

Cardiovascular/Pulmonary, Integumentary) are described in the systems review and tests and measures section of the PTCMR-SD. Other components such as Physical Environment, Medical systems, Developmental systems, and Family/Cultural Environment are important for children with spastic diplegia and also are included in this PTCMR-SD.

Tests and Measures. In this PTCMR-SD, tests and measures are organized according to the three dimensions on the personal level of the ICF: Participation, Activities, and Body Structure and Function.⁹ The Table of Tests and Measures (see Appendix A) is organized in a top-down or functional outcomes approach beginning with tests and measures in the Participation dimension and ending with tests and measures specific to the Body Structure and Function dimension. Some tests and measures cover more than one dimension of the ICF. Tests can be done solely by the physical therapist or in a team format where one professional may have the prime responsibility for guiding the child during the examination (*i.e.* arena examinations in Early Intervention). The age range of each instrument is presented in the Table of Tests and Measures. Many resources are identified in the Table of Tests and Measures (Appendix A) but be aware that other resources are available to the practitioner.²²

Findings from Tests and Measures of Medical Systems will influence physical therapy patient management and the plan of care. Physical therapy intervention strategies are designed to meet the child's individual functional and participation needs but must be modified if necessitated by the child's medical status. In the PTCMR-SD, functional mobility is identified as the primary outcome and although independent functional mobility may be a goal for all children with spastic diplegia, the goal must be modified to meet the child's medical and safety needs.

Participation. This dimension of the ICF refers to involvement in life situations or ability to engage in community activities.

General Considerations for All Ages

- Observe daily mobility routines.
- Coordinate with other providers who work with the caregiver and child in school, community, and health care system to identify mobility problems related to participation in the specified setting.^{24,25}
- Identify barriers to community integration/participation.

Special Considerations for Infants and Children (Birth to 12 Years)

- Observe play and caregiver-child interactions in a variety of environments.
- Observe teacher-child interactions and peer interactions.

Special Considerations for Youth (13 to 21 Years)

- Identify the youth's mobility needs for transition to adult services (*e.g.* educational, medical, and vocational services).^{26,27}

Activity. This dimension of the ICF refers to task performance. In this PTCMR-SD, activity refers to functional

mobility skills such as floor mobility, wheelchair mobility, and/or ambulation.

General Considerations for All Ages

● Choose appropriate tests to identify and measure specific functional mobility needs including observation and standardized norm-referenced, and criterion-referenced tests.

● Identify how assistive/adaptive devices and orthoses influence mobility task performance.

● Consider clinical gait analysis, observing temporal-spatial parameters.

Body Structure and Function. This dimension of the ICF refers to physiological functions of the body and anatomical structures. In this PTCMR-SD, impairments reflect abnormalities of these physiological functions. General information on tests and measures is presented below. Specific tests are presented according to age levels and the ICF dimension in the Table of Tests and Measures in Appendix A. (Table 3).

● **Musculoskeletal System**

1. Range of Motion (ROM):

General Considerations for All Ages

● Observe active ROM and measure passive ROM using goniometry or clinical observation.²⁸⁻³¹

● Consider specific testing for the following joint motions and muscles^{32,33} hip abduction with knees flexed (flexibility of adductors-magnus, brevis, longus) and with knees extended (gracilis flexibility), hip extension (Thomas test position in supine) with knee extended (flexibility of iliopsoas) and flexed (rectus femoris),³⁴ knee extension with hip flexion (popliteal angle- hamstring), ankle dorsiflexion with knees flexed (soleus) and extended (gastrocnemius).

2. Strength Testing:

General Considerations for All Ages

● Observe child during age appropriate functional movements with gravity eliminated and against gravity (*e.g.* rolling, kicking, reaching, crawling, high kneeling, squatting, walking, and climbing).³⁵

Specific Considerations for Preschoolers (Three to Five Years)

● Consider manual muscle testing (MMT) and/or use of hand-held dynamometry for children four to five years of age who can follow directions and attend to testing. Otherwise, assess muscle strength in a functional context.³⁶

● Conduct full lower extremity (LE) strength testing and screen upper extremities (UEs). Conduct full UE strength testing if screening results are not within normal limits (WNL).

● Conduct trunk strength testing to determine child's ability to flex and extend against gravity and isolate upper and lower trunk rotation and flexion and extension.

Specific Considerations for Children and Youth (Six to 21 Years)

● Conduct LE strength testing, using MMT, hand-held dynamometry^{37,38} and/or observation in functional context. Screen UE strength and conduct full UE strength testing if screening results are not WNL.

3. Alignment and Posture:

Specific Considerations for Infants and Preschoolers (Birth – Five Years)

- Observe for postural symmetry, test for hip joint integrity, LE alignment, leg length discrepancy (LLD).^{32,39}

Specific Considerations for Children and Youth (Six to 21 Years)

- Conduct scoliosis and LE alignment screening and test for LLD.

4. Growth:

*General Considerations for All Ages Infants and young children with CP are at risk for poor nutrition.*⁴⁰

- Review or document anthropometric (growth) measures during episodes of care. Measures may include head circumference, height, weight and calculation of Body Mass Index.⁴¹

● Neuromuscular System

General Considerations for All Ages

- Balance: Clinical observation of static and dynamic balance, reactive and anticipatory postural control,⁴² during functional activities such as reaching and playing in sitting, moving from floor to stand, reaching in standing, and walking.

- Sensory Function: Clinical observation of child's responses and reactions to tactile, auditory, visual, and vestibular stimuli.⁴³

- Motor Function: Clinical observation and/or video analysis of movement patterns during functional tasks.

- Muscle Tone: Clinical observation to determine if child has hypertonicity, hypotonicity, or dystonia including fluctuating muscle tone. For more formal testing, consider using the Modified Ashworth Scale.^{44,45} If more rigorous measures are needed, consider Holt's dynamic leg swing test⁴⁶ or consultation with a research facility to perform more sophisticated electronic testing.

Specific Considerations for Infants and Toddlers (Birth to Three Years):

- Clinical observation of primitive reflexes including the Babinski reflex and clonus, muscle tone, and balance can be examined following protocols in the Movement Assessment of Infants.

● Cardiopulmonary System^{47,48}

General Considerations for All Ages

- Endurance: Clinical observation of fatigue during play, use of timed walking tasks,⁴⁹ and use of activity monitoring systems⁵⁰ if available.

- Pulmonary function: respiratory rate; clinical observation of respiratory pattern, use of diaphragm, use of accessory muscles, color changes including cyanosis (lips, skin, fingers).

- Cardiac Function: pulse/heart rate; blood pressure, color changes including cyanosis.

● Integumentary System

General Considerations for All Ages

- Document child or youth's schedule for wearing orthoses or positioning devices such as ankle-foot orthoses, dynamic splints or bivalved casts.

- Document location of any skin irritations including blisters or persistent redness and relationship to orthoses or adaptive equipment.

- Document skin characteristics such as abnormal temperature, color, and LE nail growth.

● Medical Status; Physical Environment; Communication/Behavior; Family/Culture Systems

General Considerations for All Ages

- No specific physical therapy tests are currently available.

- Obtain pertinent past medical history from caregiver and child as appropriate; other team members/health providers; via medical, education or clinic chart review.^{51,52}

Specific Considerations for Children and Youth (Birth to 21 Years)

- Obtain information on child's medications and implications for physical therapy.

- Document frequency and duration of seizure-like activity.

- Observe visual and auditory responses during functional activities.

- Document child/youth's ability to follow simple and complex commands.

- Document communication methods used by child/youth/family.

- Document child/youth's ability to participate in age appropriate play.

- Document safety, fitting, and functional use of adaptive/assistive equipment.

- Perform home, school, and community visits as needed to observe child in natural environments.

- Discuss physical environment strengths/concerns/modifications with other team members/health providers once family permission is obtained.

- Screen child for possible nutritional concerns that may effect growth and health such as dysfunctional oral-motor control associated with hypotonia, weak suck, delayed/absent tongue lateralization; tongue thrust; weak lip closure; abnormal neurology maturation evidenced by uncoordinated swallowing mechanism, tonic bite, hyperactive gag reflex; or poor seating posture during feeding/meals due to an unstable trunk.⁵³

EVALUATION AND PHYSICAL THERAPY DIAGNOSIS

The child and family's desires and articulated needs as well as the results of the examination are considered to formulate the evaluation report. The physical therapy evaluation reflects the examiner's hypotheses for the basis of the child and family's needs related to the child's current movement problems. The physical therapy diagnosis is the primary movement problem that has brought the child/family to seek physical therapy services and is the focus of the planned episode of care. In the PTCMR-SD), the physical therapy diagnosis is difficulty with functional mobility.

PROGNOSIS AND PLAN OF CARE (INCLUDING FREQUENCY AND DURATION OF SERVICES)

Developing a plan of care is a complex problem solving activity, which requires integration of examination and evaluation findings and child and family goals. The physical therapist should incorporate components of the ICF enablement model when developing a plan of care. Primary outcomes should include functional activities and participation in life's roles.

Limited research findings are available to determine the optimal amount of intervention required for the best/most effective functional outcomes for infants, children and adolescents with cerebral palsy.^{54,55} Bower and colleagues⁵⁶⁻⁵⁸ have shown that short term (two to three weeks) intensive intervention does create short-term benefits in motor function, however the differences across a six month period between a higher (five times/week, 60 minute sessions) and a lower intensity of therapy were not significantly different. Recently, Trahan and Malouin⁵⁹ reported on the use of intermittent intensive intervention: four times per week for four weeks, followed by eight weeks of no therapy. That frequency of therapy was shown to be feasible and led to improvements in motor function in children with cerebral palsy in Gross Motor Function Classification Systems Levels IV and V.⁵⁹ Although results from their study cannot be generalized to children with spastic diplegia, they do provide some support for a variety of service delivery models. More research is needed in the area of intensity of services. The frequency and duration of physical therapy services noted below are based on current common practice in the USA.

General Considerations for All Ages

- **Outpatient setting:** Frequency and duration of PT should be individualized and based on child and family needs. When determining the frequency and duration of PT, the goal of functional mobility and ways to enhance participation and functional mobility should be considered. Periodic and episodic care is used in the management of children with spastic diplegia with follow-up appointments scheduled accordingly. Intensity of services may be higher for children with increased impairment or those who undergo selective dorsal rhizotomy (SDR)^{60,61} compared to children with milder impairments.

- **Inpatient setting:** Frequency and duration of PT is based on the child's condition and need. Daily PT may be indicated for children in orthopedic post-operative care.

Specific Considerations for Infants and Toddlers (Birth to Three Years)

- **Early intervention setting:** The team establishes the plan of care. Frequency and duration of PT is based on identified needs in the Individualized Family Service Plan (IFSP) and may be provided as direct or indirect service.^{62,63} Frequency is determined by the team and some states may have specific recommendations.

Specific Considerations for Children and Youth (Three to 21 Years)

- **School setting:**⁶⁴

- **Children (three to 12 years):** Physical therapy is a related service and is provided in the educational setting to allow children to access and participate in their educational program. Frequency and duration of PT is based on identified needs in the Individualized Education Program (IEP) and may occur in periodic episodes of care. Frequency and duration of PT are determined by the team. The child may receive either direct or indirect (consultative) physical therapy services.

- **Youth (13 to 21 years):** Frequency and duration of PT is based on identified needs in the IEP and may occur in periodic episodes of care. Physical therapy may be needed at a higher frequency when the transition plan is developed for the youth beginning at age 14 to 16 years.

Expected Outcomes. Functional outcomes for children will vary greatly depending on the severity of spastic diplegia. Severity may be influenced by the child's muscle strength, sensory systems compromise, spasticity, cognitive abilities, and medical status. Several researchers have studied the prediction of functional outcomes for children with cerebral palsy. All of the studies included some children with spastic diplegia. Montgomery⁶⁵ reviewed several of these studies⁶⁶⁻⁷¹ and reported that persistence of primitive reflexes, ability to maintain sitting, type of cerebral palsy, age/maturation and level of cognition influenced ambulation potential. Based on outcomes from three studies,^{67,70,72} Montgomery⁶⁵ reported that 86-90% children with spastic diplegia achieved some form of ambulation. More recently, Wu and colleagues⁷³ have retrospectively studied 5366 subjects with CP, 12.8% who could walk independently, and 18.4% who could walk with support. Independent predictors of walking were early motor milestones such as obtaining the ability to sit and pull to stand. Motor Development Curves have been developed to provide prognostic information about functional ability in children with cerebral palsy.⁷⁴ Although these curves are not specific for children with spastic diplegia, they still provide useful information. Longitudinal observations of motor ability included the ability to hold the head upright, maintain unsupported sitting, walk 10 steps unsupported and walk down four steps. The Gross Motor Functional Classification System (GMFCS)⁷⁵ was used to create the motor development curves. The GMFCS has five levels. Most children with spastic diplegia would be classified as Level I, II or III. Children classified in Level I walk without restrictions and have limitations in advanced gross motor skills. Level II is defined as walking without assistive devices and having limitations walking outdoors and in the community. Level III is defined as walking with assistive mobility devices and having limitations walking outdoors and in the community. Children classified in Level IV have self-mobility limitations and are transported or use power mobility in the community. Level V includes children who are dependent for mobility. The GMFCS has also been shown to correlate well with the Gross Motor Function Measure (GMFM), the Pediatric Orthopedic Data Collection Instrument, temporal-spatial gait parameters, and oxygen cost assessments.⁷⁶

General Considerations for All Ages

● As part of an IFSP or IEP, expected outcomes are developed by the team, which includes the child/youth, family, physical therapist, teachers, and other early intervention or school personnel.

● In hospital settings, goals or expected outcomes are developed by the child/youth, family, and therapist and other health professionals and focus on functional mobility in the child/youth's home or community setting.

Specific Considerations for Infants and Toddlers (Birth to Three Years)

● Outcomes should be measurable with a specific timeframe (time limited).⁸ Outcome categories may include:

- Sitting function and mobility on the floor for play
- Standing function and mobility for play
- Ambulation indoors/outdoors with or without assistive device
- Ambulation up and down stairs with assistance
- Appropriate positioning in stroller/high chair/bath chair/ride-on toy
- Family/caregiver independent in positioning
- Family satisfaction with services
- Prevention of secondary impairments by increasing and/or maintaining flexibility, strength and endurance for functional activities.

Specific Considerations for Preschoolers (Three to Five Years)

- Outcomes may include:
- Independent household mobility (floor or wheelchair mobility)
- Independent household ambulation with or without devices, including stairs
- Independent age appropriate transitions/transfers for functional mobility
- Assisted or independent community mobility
- Family able to carryout/facilitate mobility and functional skills⁷⁷
- Prevention of secondary impairments by increasing and/or maintaining flexibility, strength and endurance for functional activities.

Specific Considerations for Children (Six to 12 Years)

- Outcomes may include:
- Independent classroom or household ambulation with or without assistive devices
- Independent community ambulation with or without assistive devices for children classified as Levels I and II on the GMFCS. Some children classified as Level III on the GMFCS may require wheeled mobility for community distances
- Independent ability to get on and off the bus or use public transportation
- Independent in toileting tasks (tub and toilet transfers and clothes management)
- Independent age appropriate transitions/transfers for functional mobility
- Independent mobility on stairs with or without a railing

● Independent ability to negotiate through inside doors and heavier doors leading to outside

● Independent ability to use appropriate/desired playground equipment

● Teacher/aides able to carry out/facilitate mobility and functional skills⁷⁸

● Family able to carry out/facilitate mobility and functional skills

● Increased/maintained flexibility, strength and endurance for functional activities

● Prevention of future deformity/pain

● Development of initial skills in self advocacy and self-determination.^{27,79}

Specific Considerations for Youth (13 to 21 Years)

● Outcomes may include:

● Independent mobility around home, school, including stairs, bathroom, cafeteria, locker room, school and community buses, etc., with or without a device or using wheeled mobility

● Independent ability to negotiate in community for regular activity and job training

● Independent timely mobility between classes at school

● Independent participation in fitness and recreational movement program

● Self advocacy and self-determination^{27,79,80}

● Ability to maintain/increase flexibility, strength and endurance for functional activities

● Ability to lead transition planning to adult services.

INTERVENTION

A. Coordination, Communication, and Documentation. These are processes intended to ensure high quality of care. They include working and communicating with all parties involved with the child and family and documenting services and care provided.⁸

General Considerations for All Ages

● Maintain coordination of services and communication with all team members or health providers that participate in the infant/child/youth's care. Consider co-visits when appropriate. Document all levels of intervention that the infant/child/youth and family engage in during therapy sessions and for overall plan of care.⁶³

● Use documentation guidelines set by the work setting and third party payers.

● Communicate in writing to family and other providers as appropriate. For physical therapists working in the school system, written permission from the child's parents/legal guardian is necessary prior to communicating with healthcare providers outside of the school system.²² For therapists working in health or medical settings, be sure to follow worksite guidelines on sharing patient information under HIPAA (the Health Information Portability and Accountability Act).

● Other providers that physical therapists communicate with may include durable medical equipment vendors and orthotists regarding assistive technology and orthoses.

● Consider referral to other resources (such as family

support groups, public programs, advocacy groups) and community activities (such as centers for independent living and recreation centers) to support the family's and infant's, child's, or youth's identified outcomes.

- Assist with transition for discharge or to the next appropriate service system (*i.e.* from EI to school, from school to adult services).⁸⁰

- Engage child/youth in health care decisions to help the child/youth develop self-advocacy and independent living skills.

- Communicate with families about spasticity management options, which may improve child's function and participation. Spasticity management options include referral to a medical or rehabilitation team for evaluation and recommendations for medical intervention (oral medications, botulinum toxin injections and phenol blocks) or surgical interventions (orthopedic including muscle and bony procedures and neurosurgery including selective dorsal rhizotomy and baclofen pump); coordination of therapy interventions after medical management for spasticity; and documentation of anticipated outcomes and child's progress/functional status in therapy.⁸¹

- Communicate with families about common orthopedic procedures such as femoral osteotomies and muscle lengthening and participate in team decision making about the procedures and the impact of functional mobility.^{32,82-88}

- Observe and record/report seizure activity during PT sessions as per child's plan of care.

- Consider referral to improve oral-motor abilities when you determine/identify intervention strategies and outcomes.⁴⁰

- Consider referral for nutritional evaluation if the child is overweight or underweight or at risk for overweight or underweight.

Specific Considerations for Infants and Preschoolers (Birth to Five Years)

- For physical therapists practicing under the Individuals with Disabilities Education Act [IDEA] (PL 105-17), it is strongly recommended that they communicate with state lead agencies and state and county Interagency Coordination Councils (ICCs) to become familiar with policies, procedures, and resources that affect service delivery for children and their families in their region of practice.

- This level of intervention involves direct collaboration with key individuals in the infant/child's life. These individuals include the infant's/child's service coordinator from the EI agency and other EI team members (family members, medical providers, and early childhood educators).⁸⁹ Also it is advisable to communicate with key individuals who may not be able to be present during intervention visits (*i.e.* parents if the child is served at a daycare or preschool; father if the mother is typically present when the child is served in the home).

- For physical therapists serving children in health care settings, ongoing communication with the child's health and early intervention providers is critical.

- Communication with family, teachers, and other

healthcare providers is especially important as the child transitions from an early intervention program to a pre-school program.

- Therapists document examination findings as part of the IFSP (birth to three years) and IEP (three to five years). Therapists also routinely document a child's functional status and progress on outcomes and objectives.

- For children receiving physical therapy in health care settings, the therapist documents examination findings, plan of care, intervention provided and functional status based on policies of the setting and third party payers.

Specific Considerations for Children (Six to 21 Years)

- Ongoing communication with the child and the child's team in a family-focused, culturally acceptable manner is important.⁹⁰ Some youth may receive services at two different settings such as at school and an outpatient clinic/hospital setting and communication is coordinated across settings.

- Ongoing communication with the child or youth's team is important. The team may include but not be limited to parents, caregivers, MDs, orthotist, durable medical equipment vendor, and school personnel (special education teacher, regular education teacher, physical education teacher, counselor, psychologist, occupational therapist, speech therapist, etc).

- *For youth 13 to 21 years:* Communicate with job or high school/college guidance counselor, community work place supervisor, and other community program advisors as the youth moves towards school graduation.

- Communication topics may include child or youth's motor disability, safety and awareness during mobility, behavioral control, medically related issues such as seizure disorder, cardio-pulmonary disorders such as asthma, etc., medical management of muscle tone (botulinum toxin, baclofen, SDR), ankle and foot orthoses, adaptive equipment (crutches, walkers, wheelchairs), musculoskeletal integrity, school physical education program, and opportunities for recreation such as swimming, therapeutic horseback riding, and other sports or fitness programs.

- *For youth 13 to 21 years:* Communication topics may include issues about specific motor skills required for various jobs or negotiating college campuses.

- Therapists participate in developing an IEP with the student, the parents and other school team members. Physical therapists document a child or youth's functional status and yearly goals on the IEP. In addition, physical therapists provide yearly evaluations, three-year evaluations and quarterly reports on the status of goals.

- *For youth 13 to 21 years:* During the transition from school to college or other community placements, physical therapists participate in the meetings and documentation required for transition planning.

- In healthcare settings, therapists document examination findings, plan of care, intervention provided and functional status based on policies of the setting and third party payers.

B. Patient-related Instruction. This involves informing, educating and training children, youth, families and caregivers for the purpose of promoting optimal care.⁸ Instruction may include providing information about the diagnosis of spastic diplegia, plan of care, transition from one service delivery system to another, need for a health and fitness program, and strategies to practice functional mobility during daily routines.

General Considerations for All Ages

- Discuss and identify areas in which the caregiver and child need support to participate in the physical therapy plan of care

- Provide culturally appropriate instruction to the caregiver and child in the manner that is best for them (demonstration, written, verbal, video) to ensure that practice of functional activities occurs so the child can improve functional mobility and increase participation in home, school, and community.⁹¹ Written and video instruction may improve home and school program adherence. Therapists should also consider the stresses of caregivers when developing a home program and requesting caregivers to carryout additional home activities.^{92,93}

Specific Considerations for Infants and Preschoolers (Birth to Five Years)

- The majority of patient-related instruction is in the form of reciprocal information exchange between therapist and family including parents, siblings, extended family, and childcare workers.

- Patient-related instruction may include but not be limited to carrying, positioning and handling techniques, care-giving strategies for feeding, bathing, dressing; stretching exercises, parent—child interactions and play activities, task and environment adaptations.^{94–96}

- Physical therapists provide recommendations for home program activities that are meaningful and understandable to the family and can become a part of the child's typical day.⁹⁷ Verbal, written and/or video instruction may be provided.^{98,99}

Specific Considerations for Children (Six to 21 Years)

- Patient-related instruction is provided to the caregivers including the child, parents, extended family, and school and childcare workers. As children become older, primary patient-related instruction is directed to them and designed to meet their needs.

- *For youth (13 to 21 years):* Patient-related instruction is provided primarily to the youth.

- Patient-related instruction may include but not be limited to identifying health and fitness needs; teaching self-ROM exercises; self-relaxation techniques (breathing, Feldenkrais, yoga, etc.); posture and body mechanics, managing orthoses and adaptive equipment; and safety awareness (e.g. safety issues for ambulation in crowded hallways, in public areas/stores, unusual environments, escalators, and understanding the need for assistance and how to ask for it).

- Self-awareness and self-determination training:

- *For children six to 12 years:* As part of self-awareness and self-determination training, communication often be-

gins with the child, so that he or she can gradually learn about self and disability and choices to be made based on his or her culture and values.²⁷

- *For youth 13 to 21 years:* As part of self-awareness and self-determination training, communication is focused on the youth, so that he/she can learn as much as possible about self and disability and choices to be made based on his/her culture and values. If the youth is capable, he/she will learn to communicate with his/her team members efficiently about the need for assistance, safety needs, pain concerns, fitness, medical needs, interests, beliefs, and values. The youth will learn how to access community resources. Or if the youth is not capable of independently accessing the community, then the family or caregivers learn to assist the youth in community participation.²⁷

- Family and caregiver instruction may include positioning and handling techniques, stretching exercises, facilitating recreational activities, adapting task and environment for optimal participation, assisting with exercise and fitness needs, and providing information on community resources.

C. Procedural Intervention. This involves the use of physical therapy procedures and techniques to produce an improvement in the life and function of a child or youth with spastic diplegia. Procedural interventions address a child's limitations in body and/or environmental systems and are focused on improving functional mobility outcomes.⁸

Overall Purposes

- Implement strategies to improve functional mobility and increase participation at home, in school and community and in play situations

- Adapt the tasks or movement experiences to meet the strengths and challenges of the individual child

- Involve family and school staff to help reinforce and generalize mobility skills

- Address systems that may limit functional mobility goals.

1. Musculoskeletal and Neuromuscular Systems - Including Strength, ROM, Alignment and Posture, Balance, Motor Function, Tone and Movement Patterns

General Considerations for All Ages

- Musculoskeletal and neuromuscular systems are presented together because components of each system are interdependent.

- Intervention strategies are designed to improve the following areas:

- Neuromuscular system: balance, coordination, motor learning, motor function, movement patterns, sensory motor integration

- Musculoskeletal system: strength, ROM, alignment/posture

- When implementing any of the following activity-focused intervention strategies consider motor learning principles. Motor learning is a set of processes which lead to permanent changes in functional motor abilities. Examples of motor learning strategies include varied practice

schedules, use of augmented information including instruction, demonstration, verbal cues, manual guidance, visual, auditory and tactile feedback, and use of cognitive strategies.^{99–103}

- Intervention strategies are implemented in the context of functional activities to encourage independent mobility.¹⁰⁴ Play is an important component of intervention for children.

Specific Considerations for Infants and Preschoolers (Birth to Five Years)

- *Infants and toddlers (birth to three years)*: The following procedural interventions are most often provided in the home or childcare setting which is the “natural environment.”

- *Preschoolers (three to five years)*: The following procedural interventions are most often provided in the preschool setting.

Specific Considerations for Children (Six to 12 Years)

- The following procedural interventions may take place in the school, home, or health care setting.

Interventions

- **Strengthening:**

- *Infants and preschoolers (birth to five years)*: Strategies are introduced during play. Consider using therapy balls, aquatic therapy and hippotherapy.^{105–106}

- *Children and youth (six to 21 years)*: Strengthening during play and/or direct resistive exercises. Consider using theraband, cuff weights, free weights, weight machines, and other exercise equipment. Researchers have examined the intensity of strength training for children with spastic diplegia. To demonstrate an increase in strength, recommendations include two to three times per week for six to 10 weeks at 65% of maximum isometric strength or between three to 10 repetitions maximum.^{107–109} Continuation of strength training over 10 weeks is also recommended for increasing or maintaining strength. Evidence supports that strengthening does not increase spasticity.^{107,110–113} Evidence also supports that strength ability is correlated to ability to balance in children with CP.¹¹⁴ Preliminary evidence suggests that strength training improves gait in individuals with cerebral palsy.^{108,110,115,116–120}

- Other effective strengthening strategies include electrical stimulation,^{109–111} bike riding,¹²¹ aquatics,¹⁰⁶ and hippotherapy.^{122–124} Hippotherapy has also recently been shown to improve muscle symmetry.¹²⁵

- **Stretching Exercises**

- *Infants and preschoolers (birth to five years)*: Positioning and stretching to improve alignment, ROM, and function (e.g. long sitting with protection of lumbar spine to stretch hamstrings and abducted sitting to stretch hip adductors) Improvements in hamstring length have been associated with improvement of temporal patterns during gait of both the semitendinosus and vastus lateralis muscles.¹²⁶

- *Children and youth (six to 21 years)*: Begin teaching self ROM exercises. Consider serial casting in conjunction with botulinum toxin A injections for gastrocnemius and soleus muscle tightness that does not respond to injections

alone.¹²⁷ Consider short leg bivalved casts or dynamic splints for nighttime positioning to increase or maintain flexibility in gastrocnemius or soleus muscles. Children with CP who use an equinus gait pattern may demonstrate shortening of these muscles, even if there is no contracture at the ankle.¹²⁸

- **Balance/Postural Control and Coordination Activities**

- Exercise to increase balance and coordination for function, such as hippotherapy,^{122–124} neurodevelopmental therapy techniques,^{129,130} self-generated and therapist generated perturbations in sit and stand and use of orthoses.^{131–133,42}

- **Functional Activities**

- Activities include floor mobility, sitting posture and stability, transitions in/out of sitting, transitions to/from sit to stand and ambulation. Practice mobility on rough uneven ground through contrived or natural obstacle courses, on stairs or ramps, and through doors. Provide instruction demonstration, guidance and feedback as indicated.

- Motor training and manual guidance for development of functional movement patterns^{134,135}

- Treadmill walking^{136,137}

- Computer assisted instruction to improve lower extremity function especially ankle function¹³⁸

- Neuromuscular electrical stimulation during functional activity^{139–142}

- Ankle-foot orthoses to improve gait and functional movements^{143–145}

- Referral for botulinum toxin injections to be accompanied by exercise to improve gait in children with CP^{146–148}

- Consider bicycle riding, walking, swimming and aquatic gait exercise, hippotherapy or recreational horseback riding.

- Use of EMG feedback during gait, auditory feedback of gait parameters, and/or electrical stimulation during gait could be beneficial for learning more efficient and flexible alignment and coordination patterns.^{99,118–120,149}

- Teach the child strategies to deal with abnormal muscle tone during functional mobility.¹⁵⁰

Specific Considerations for Children and Youth (6-21 Years): Encourage youth to develop a movement practice schedule involving movement through difficult terrains, on bleachers, escalators, bus steps, in moving vehicles such as public transportation, stores and other community environments.

- Consider martial arts, adapted sports programs, bicycle riding, track exercise, swimming and aquatic gait exercise, hippotherapy or recreational horseback riding.

- Provide consultation for the youth who desire to learn a new sport or motor activity.^{151,152}

2. Cardiopulmonary System—Including Endurance, Pulmonary and Cardiac Function. Children with cerebral palsy may have compromised cardiopulmonary systems. Intervention strategies should include techniques to improve cardio respiratory endurance. For typically developing children, 30 to 60 minutes of moderate to vigorous intensity

physical activity, three to six times per week is recommended for overall health benefits.^{61,153,154} Children with cerebral palsy (CP) are considerably less active than their peers without disability and do not exercise at high enough intensity to increase fitness.¹⁵⁵⁻¹⁵⁷ Inactivity may be due to difficulty accessing appropriate programs or availability of programs or accessible equipment. Several randomized control trials are currently underway to assist in better determining outcomes from fitness training for children with cerebral palsy (personal communication: Fowler, EG, 2005).

General Considerations for All Ages

- Adapt interventions to account for the fact that children with cerebral palsy usually have lower maximum exercise capacity, muscle power and endurance. They experience a higher metabolic cost during submaximal exercise and fatigue faster than children who are typically developing.^{47,155,157-159}

- Interventions that include endurance/aerobic training for children with cerebral palsy may result in improved peak aerobic power.¹⁵⁷

- During intervention sessions to improve cardiopulmonary function, monitor vital and clinical signs such as heart rate, rate of perceived exertion; dyspnea on exertion; cyanosis; diaphoresis (as indications of systems under stress).⁴⁷

- Provide interventions to improve cardiopulmonary endurance and tolerance for physical activity. Consider the child's age, developmental level, level of disability, cardiopulmonary compromise, and movement patterns when designing an endurance program.

- Provide instruction on endurance training *i.e.* proper use of cardio-training equipment such as treadmills, stationary bikes, recumbent bikes, elliptical trainers, and steppers, which equipment is best to prevent injury, and how to adjust equipment for appropriate fit. Recommend training intensity by using perceived exertion scales or training heart rate levels. Instruct the child in how to monitor his/her heart rate or perceived exertion.¹⁶⁰

- Provide instruction for energy conservation for task completion.

- Older children should become involved in exercise decisions to include elements of self-care and self-determination in physical activities.

Special Considerations for Infants and Preschoolers (Birth – 5 Years)

- Use a family-centered approach by including caregivers in activities and strategies to increase a child's physical activity and to enhance cardiopulmonary capacity.⁹⁰

- Play is an important intervention strategy to enhance mobility and cardiopulmonary capacity.

- It is hard to motivate younger children for long periods of exercise, a goal of 10 to 15 minutes of intense activity interspersed with recreational games for 30 to 45 minutes for two sessions a week will result in a training effect in a few weeks.¹⁶¹

Special Considerations for Children and Youth (Six to 21 Years)

- Involve children in choice and design of exercise

programs to focus on self-care and self-determination skill building.

- Teach youth to understand and control their health and fitness and maintain or improve compromised systems.

- Youth and family support and information exchange are important to identify useful resources when developing recreational activities. School participation and activities should be encouraged to enhance functional mobility, exercise for health and fitness, and develop interest in life sport and other community activity.

- Due to lower activity levels, youth with compromise to these systems are at risk for being overweight and impairments that lead to loss of functional mobility.

- Consult with a dietitian/MD/physical education teacher and family to maintain youth/child's daily physical activity levels.

- Possible physical therapy activities include exercising with a medicine ball and pulleys, walking on ground or treadmill, bike riding, jump rope, trampoline, swimming, other water games, and wheelchair propulsion.

3. Integumentary System

General Considerations for All Ages

- Consider movement strategies for activities, positioning, and postures that will prevent skin breakdown, disturbed sensations, and relieve pain.⁸

- Check skin during PT sessions for children who have received new devices, have existing problems with their orthoses or have had recent growth spurts.

- Teach family/caregivers/child/youth how to don/doff orthoses and check skin.

- Adapt/adjust orthoses, casts, positioning devices or contact orthotist or have family/youth contact orthotist. Establish schedule for wearing orthoses considering child's/family's needs, setting etc. Assist family/caregivers with establishing the schedule.

4. Physical Environment - Including Home, School, and Community Resources, Transportation Needs and Equipment Needs

General Considerations for All Ages

- Physical therapists prescribe and provide training in the use of adaptive equipment or orthotic devices to improve child and environmental constraints to optimize functional mobility.^{36,133} Equipment needs are addressed in light of all the identified physical, societal and emotional needs of the child, as well as the family home environment; the child's school, transportation issues (public transit, school bus, car); and the necessity and importance of moving about and participating in community activities. Specific attention should be given to the need for different types of equipment for different mobility tasks that may be influenced by the environmental demands.¹⁶²

- Equipment considerations to improve alignment, ROM, and functional mobility include:^{32,36} lower extremity splinting, serial casting, orthotic devices¹⁶³ and adaptive devices (such as seating systems, standing tables,^{164,165} night splints for stretching,¹⁶³ as well as walkers and crutches).

- For children who need a walker, consider a posterior rolling walker which may have the advantage of facilitating upright positioning, increased gait velocity, and decreased double stance time as compared to anterior walkers.^{166,167}

- Teach youth self-management of these adaptive devices. Consider an episode of care for changes related to growth spurt, pain syndrome, or for consultation about orthoses.³⁶

- Consider a home visit or community visit (*i.e.* day care center) to assess child's physical environment and need for modifications, adaptations, accommodations, or assistive devices.²²

- Consider the family transportation needs and assist in obtaining the means to get the child/youth to participate in community activities.

- Determine equipment needs for the child in the home and community with a goal to maximize functional independence or ease of caregiving for the parent. Possible equipment for the home, school and community may include, bathroom equipment (shower chair, raised toilet seat, grab bars), car seat, car/van adaptations, manual wheelchair, power wheelchair or scooter. The child/youth may require different equipment for mobility needs, such as a walker for short distances and a wheelchair for longer distances.

- Teach the child/youth and family safe and efficient use of the adaptive equipment for negotiating different environments.

- Assist the family and the child/youth in obtaining resources for environmental modifications as needed.

Specific Considerations for Infants and Preschoolers (Birth to Five Years)

- An infant or child may require adaptive equipment or assistive devices to achieve functional mobility (*i.e.* posterior walker, ankle foot orthoses (AFOs)).^{166,167}

- Equipment needs are addressed based on child's function and environmental needs. Examples: Does the child need mobility (*i.e.* wheelchair, stroller, walker, push toy) or positioning (*i.e.* seating, stander) devices? Does the family home have stairs? Does the family have a car or use public transportation?

Specific Considerations for Children or Youth (Six to 21 Years)

- As children age, they may need additional assistive devices or modifications to current devices. Growth and environmental changes due to age and home, school, or community activities may warrant new or modified devices. It is important that the child, family, school and therapist monitor a child's need for and use of equipment. As the child ages, it is important that he/she understands how to maintain and use assistive devices/adaptive equipment appropriately and independently and how to make proper choices for equipment/device needs.

- Examples of times when child may need new or modified assistive devices/adaptive equipment:

- Child may need mobility device for independence

and for keeping up with peers (*i.e.* larger schools and need to get to classes in a timely fashion; field trips with class).

- Child may undergo surgical interventions or may experience changes in ROM or muscle tone, which may require new devices.

- Child may worry about his/her appearance, or may be exposed to more difficult environments in which to negotiate safely (ex. having to cross streets, participating in more complex sports activities/environments, etc.).

- Provide home or school modifications and equipment to meet the needs of the child (for example, a powered chair). Modification and equipment information are discussed with the child, family, and school personnel. Specialized vendors can help with equipment needs.

D. Additional Considerations When Implementing Procedural Interventions

1. Medical Systems—Such As Nutrition And Feeding; Seizure Activity; Vision And Hearing; Bowel And Bladder Function

● Nutrition and Feeding

General Considerations for All Ages

- Children with CP are more likely than their peers to have malnutrition, obesity, and adverse drug-nutrient interactions^{168–171}

- Children with CP who are underweight may have low percent body fat and fat free mass,¹⁵⁶ increased caloric requirements,¹⁷² feeding problems,^{173,174} excessive energy consumption,^{175–177} and fatigue.^{178–180}

- Poor nourishment in children with CP is associated with increased hospitalization, decreased participation in typical activities, missed days at school.¹⁸¹

● Bone Density

General Consideration for All Ages

- Non-nutritional factors, such as reduced ambulation, can contribute to decreased bone density.¹⁸² Reduced bone mineral density has been reported in the lumbar vertebra and femoral neck^{183,184} of children with cerebral palsy. Bone mineral density is correlated with ambulation status and age at which a child began to walk. Children with better ambulatory status are more likely to have better bone mineral density levels.¹⁸⁴

- Children with spastic diplegia and hemiplegia have similar levels of bone mineral density; both values are lower than those for children who are typically developing but higher than for children with quadriplegia.¹⁸⁴

- Children with spastic cerebral palsy have shown increased bone mineral density after an eight-month physical activity program.¹⁸³

- Bone mineral density also may be compromised by nutritional problems and anti-convulsive medication.¹⁸⁴

● Seizure Activity

General Considerations for All Ages

- Research findings indicate that 43% of children with neonatal seizures and abnormal neurologic examinations were ultimately diagnosed with CP.¹⁸⁵

- Be aware of a child's seizure history and activity and seizure medications. Document any seizure activity during therapy sessions.

- Modify intervention strategies if a child's seizure activity is exacerbated by therapy.

- **Vision and Hearing**

- General Considerations for All Ages*

- In a population-based study of children with CP, both vision and hearing were significantly associated with GMFCS levels suggesting increased limitations in vision and hearing with increased severity of CP.¹⁸⁶

- If a child has decreased vision, consider accommodations such as providing feedback with increased auditory, tactile, and light features. For younger children, use toys that provide these types of feedback.

- If a child has a hearing impairment, be aware of how to assist the child with using hearing aids or sign language. When providing instructions, use visual and manual guidance. For older children, use pictures or written instructions for home programs if appropriate.

- **Bowel and Bladder Function**

- General Considerations for All Ages*

- Constipation¹⁸⁷ and neurogenic bladder (spastic bladder) may be problematic for children with CP. Children who have mental retardation along with primary diagnosis of CP may not be able to be toilet trained and may therefore, be dependent in toileting.

- Encourage movement/exercise and upright posture which may improve digestive and elimination activity.

- 2. Developmental Systems—Such As Cognition, Communication, Social/Emotional Issues, Affect, Behavior and Temperament/Resiliency**

- General Considerations For All Ages*

- PT intervention is provided within the context of the child's identified developmental outcomes, respecting the child's development in all domains.

- Consideration is given to the infant's need to develop competency in self-regulation.

- PT intervention is provided in a way to help the child attend to task, to decrease distractibility while performing and learning motor skills.

- Consider sensory integration and modulation when observing or requesting a motor task from the child.

- PT intervention should be challenging and as age appropriate as possible given the child's abilities. Do not overwhelm the child/youth but try to ensure success by achieving outcomes while challenging the child to learn the functional skill.

- Working toward automaticity of mobility functions is important for shared attention tasks in the functional environment.

- 3. Family/Cultural Environment—Including Caregiver-Child Interaction, Supports And Resources, Learning Styles, Cultural Beliefs, Demographic Information, And Family Constellation**

- General Considerations for All Ages*

- Use a child/youth first approach in providing PT to a child and his/her family.^{79,188–190}

- Foster parent-child interaction during intervention.

- Foster self-determination in children to encourage independence in self-care.

- Consider the family and physical environments that the child will experience as he/she ages with spastic diplegia.

- Establish opportunities for peer interaction and modeling in intervention sessions, especially for older children.

- Focus on improving participation by decreasing functional limitations.

- Take into account the child or youth's age, learning style, maturity, and belief systems when planning interventions.

- Acknowledge child and family values and culture when providing services.

- Regardless of intervention environment (home, community, school, hospital) the intervention session needs to meet the learning style/abilities of the child and family; provide meaningful activities to achieve child and family needs; and be integrated into the child and family routines to be successful.

- 4. Transitions from Adolescence to Young Adulthood.** For young adults with special health care needs, a primary goal of transitions in health care is to maximize function and lifelong potential by providing appropriate, uninterrupted health services.¹⁹¹ Physical therapists often provide health services to young adults with spastic diplegia in their transition from related services under IDEA to adult services. Physical therapists may take the role as a consultant and provide community-based interventions to facilitate a student's transition to successful participation in the community as an adult. Essential elements of physical therapy services during this transition process include:¹⁹²

- An outcome oriented process to promote the move from a school environment to post-school activities including work-related activities;

- A focus on the individual's needs including preferences and interests;

- Provision of coordinated activities across team members for successful therapy interventions;

- Promotion of the successful transition to the post-secondary environment so that therapy interventions focus on student's transition needs to typical community environments.

RE-EXAMINATION

After an episode of care, a child and family should undergo a reexamination to determine if outcomes/goals have been achieved. If goals are achieved, then the child is discharged from service and may be referred to community agency/resources for recreation or other physical activity services. If goals are only partially achieved or not achieved, then the plan of care for the child and family is revised and services may be continued if appropriate.

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Appendix A TABLE 3

Appendix A: Table of Tests and Measures

Level of enablement [WHO]	Test	Age Range	Purpose of test	Description
Participation	Canadian Occupational Performance Measure (COPM) ^{193,194}	Any age	Identifies changes in parent or child's self-perception of performance over time.	Provides satisfaction and disability ratings for daily activities and routines, which are identified by the child and family as an important part of daily life. Information is gathered through parent and/or child interview.
Participation	Child Health Questionnaire (CHQ) ¹⁹⁵⁻¹⁹⁷	2 months – 17 years	Measures quality of life	Provides information on physical and psychosocial health concepts. The questionnaire is completed by parent and/or child. There are several versions depending on the child's age, parent versus child report, and length of questionnaire.
Participation	Child Health Assessment Questionnaire (CHAQ) ¹⁹⁸	Any age	Measures quality of life	Developed primarily for children with arthritis but has been used for children with other physical disabilities. Questionnaire in which ability to do various ADLs and amount of assistance required is rated by child and/or caregiver.
Participation	Health Utilities Index – Mark 3 (HUI-3) ^{199,200}	Any age	Measures children's functional health status; can compute cardinal utility value to represent Health Related Quality of Life	Questionnaire completed by caregiver in eight domains: Ambulation, Dexterity, Vision, Hearing, Cognition, Emotion, and Pain
Participation/Activity	Pediatric Evaluation of Disability Inventory (PEDI) ²⁰¹⁻²⁰⁸	6 months to 7.5 years or any age as long as mobility skills are under 7.5 years	Measures self-care and mobility capabilities and performance in the home and community environments. Detects change over time and can be used to monitor progress.	Functional Skills and Caregiver Assistance sections for each of the three domains of Self-care, Mobility and Social Function; Observed or rated through interview with child and/or caregiver. Normative and scaled scores are available.
Participation/Activity	School Function Assessment (SFA) ^{209,210}	Elementary school students	Measures function in the school environment and can be used to guide program planning	Three parts: Participation in school activity settings; Task supports; Activity Performance. Includes physical and cognitive/behavioral tasks. Criterion-referenced and scaled scores are available. Designed to be used in an integrated setting and requires input from all team members in order to represent a student's performance in a variety of environments.
Participation/Body Structure/Function	Sensory Profile ²¹¹⁻²¹⁴	3-10 years	Determines which sensory processes contribute to performance strengths and barriers in a child's life	Parent questionnaire, which rates child's sensory system responses to different activities/environments. Nine factors scored from caregiver's ratings: Sensory seeking; Emotionally reactive; Low endurance/Tone; Oral sensory seeking; Inattention/Distractibility; Poor registration; Sensory sensitivity; Sensory; Fine motor/Perceptual
Activity	Functional Independence Measure for Children (Wee FIM) ²¹⁵⁻²²⁰	6 months to 7 years	Measures changes in mobility and ADL skills. Can be used for program evaluation and rehabilitation outcomes.	Performance in self-care, sphincter control, transfers, locomotion, communication and social cognition. Criterion-referenced. Outcomes are sent to the Universal Data System for Medical Rehabilitation for outcome reporting and external benchmarking.
Activity	Functional Independence Measure (FIM) ²²¹⁻²²³	7 years through adulthood	Measures changes in mobility and ADL skills. Can be used for program evaluation and rehabilitation outcomes.	Performance in self-care, sphincter control, transfers, locomotion, communication and social cognition. Criterion-referenced. Outcomes are sent to the Universal Data System for Medical Rehabilitation for outcome reporting and external benchmarking.
Activity	Gross Motor Function Measure (GMFM) ²²⁴⁻²²⁸	Birth – 5 years or Any age as long as gross motor skills are less than 5 years	Measures gross motor skills and can be used to monitor progress of children with cerebral palsy and other disabilities.	Criterion-referenced performance based test with five dimensions: Lying and rolling; Sitting; Crawling and kneeling; Standing; and Walking, Running, Jumping. There are 2 versions of the GMFM: one with 88 items and the other with 60 items. Scaled scores are available for the 60 item version.
Activity	Alberta Infant Motor Scale (AIMS) ²²⁹⁻²³²	Birth to 18 months	Identifies motor delays in infants and measures change in motor skills over time.	Performance based and norm referenced. Tests motor development in prone, supine, sitting and standing positions. Documents some quality of movement items such as posture and weight bearing. Norm-referenced.
Activity	Toddler and Infant Motor Evaluation (TIME) ²³³⁻²³⁶	4 months to 3.5 years	Identifies children with mild to severe motor problems. Measures sensory and motor development and can be used to monitor progress.	Contains five subtests: Mobility, Stability, Motor Organization, Functional Performance, and Social-emotional Abilities.
Activity	Bayley Scales of Infant Development, 2nd edition (BSID-II) ^{237,238}	1-42 months	Identifies developmental gross motor, fine motor, and cognitive delays. Can be used to monitor progress.	Measures development on two scales: Mental which includes language and perceptual skills and Motor which includes gross motor and fine motor behavior. Norm-referenced
Activity	Battelle Developmental Inventory ^{197,239-241}	Birth to 8 years	Identifies developmental level of infant or young child and can be used to monitor changes over time.	Judgment of performance based measure administered through structured format, interviews with caregivers or naturalistic observations. Contains Gross Motor, Fine Motor, Personal-social, Adaptive, Communication, and Cognition items. Norm-referenced.
Activity	Early Intervention Developmental Profile ²⁴²	Birth – 3	Developmental screening tool	Provides information on the following areas: cognition, gross motor, language, perceptual/fine motor, self-care, social/emotional development.
Activity	Standardized Walking Obstacle Course ^{243,244}	Any age child or youth who is able to walk independently	Measures stability and speed of gait in a natural and functional setting.	The obstacle course is 12.2 meters long by 0.9 meters wide. The course requires negotiating three directional turns of 30, 90 and 70 degrees, stepping over obstacle, walking on different surfaces, and moving from sit to stand and stand to sit
Activity	Functional Mobility Scale (FMS) ²⁴⁵	Any age child or youth who is able to walk independently Any age independently Any age 32 weeks gestational age to four months	Measures speed of mobility across three distances.	Functional mobility scored over three distances chosen to represent mobility in the home, school, and community
Activity/Body Structure/Function	Test of Infant Motor Performance (TIMP) ²⁴⁶⁻²⁵¹	32 weeks gestational age to four months	Provides early identification of motor delays; assesses postural control for early skill acquisition	Two scales: Observed scale of infant's spontaneous movements; and elicited scale of infant's postural and movement response to handling.

TABLE 3
Continued.

Level of enablement [WHO]	Test	Age Range	Purpose of test	Description
Activity/ Body Structure/ Function	Harris Infant Neuromotor Test (HINT) ²⁵⁶⁻²⁵⁴	0-12 months	Screening tool; identifies neuromotor differences in infants aged 3 to 12 months.	Five item parent/caregiver section; 21 item infant assessment section including motor behaviors in supine-lying, prone-lying, transitions from prone and supine, supported sitting, and supported standing; head circumference measurement; and a two part developmental and qualitative judgment item.
Activity/ Body Structure/ Function	Movement Assessment of Infants (MAI) ²⁵⁶⁻²⁵⁷	0-12 months	Identifies motor dysfunction in infants and can be used to monitor motor abilities in infants.	Four sections: Muscle Tone, Primitive Reflexes, Automatic Reactions, and Volitional Movement. Criterion referenced and normative information available for 4 and 8 month old infants only.
Activity/Body Structure/ Function	Bruninks-Oseretsky Test of Motor Proficiency (BOTMP) ²⁵⁸⁻²⁵⁹	4.5-14.5 years	Identifies motor abilities and can be used for program planning. Can also be used to monitor change over longer periods of time for children with mild disabilities.	Gross Motor subtests include: Running Speed and Agility, Strength, Balance, and Coordination. Norm-referenced.
Activity/Body Structure/ Function	Movement Assessment Battery for Children (M-ABC) ²⁶⁰⁻²⁶⁰	4-12 years	Identifies and describes impairments of motor function	This test consists of a Performance Test for a standardized assessment of manual dexterity, ball skills, and static and dynamic balance and a Checklist used by parents, teachers, or other professionals over a 1-2 week period to score items that are part of a child's daily routine and ADL's. Norm referenced.
Activity/ Body Structure/ Function	Peabody Developmental Motor Scales, 2nd ed (PDMS-2) ^{260- 262}	Birth to 5 years	Identifies gross and fine motor delays and can be used to monitor progress.	Has a gross motor and fine motor scale. Gross Motor Scale contains: Reflexes, Stationary, Locomotion, Object manipulation. Fine Motor contains: Grasping, Visual-motor integration. Norm referenced.
Activity/Body Structure/ Function	Test of Gross Motor Development-2 (TGMD-2) ²⁶⁸⁻²⁶⁹	3-10 years	To determine a child's acquisition of selected gross motor tasks	Tests the areas of locomotion and object control with each item having three or four specific performance criteria to indicate child's skill maturity on the item. Test is administered using specific materials and standardized procedures.
Activity/Body Structure/ Function	Timed Up and Down Stairs test (TUDS) ²⁶⁵	Any age child or youth who can walk independently up and down stairs	Measures time to ascend and descend stairs	The child is timed while walking up and down a set of stairs. The gait pattern is also described.
Body Structure/ Function	Observational Gait Scale (OGS) ²⁶⁴	6 yrs-adult	Structured scale to rate gait parameters	Modified version of the Physicians Rating Scale. Seven sections rated: Knee mid-stance; Initial foot contact; Foot contact mid-stance; Heel rise; Hind foot; Base of support; Assistive devices
Body Structure/ Function	Test of Sensory Function in Infants ²⁶⁷⁻²⁶⁸	4-18 months	Assists in diagnosing sensory processing dysfunction. Identifies children ages 4-18 months who are at risk for future developmental delay and learning deficits.	Performance based test with five subtests: 1) reactivity to tactile deep pressure 2) vestibular stimulation, 3) adaptive motor function, 4) visual tactile integration, and 5) oculomotor control.
Body Structure/ Function	Sensory Integration and Praxis Test ²⁶⁹	4-8 yrs 11 months	Measures the sensory systems contributions to balance and motor coordination	Numerous tests of postural control, motor coordination and planning, fine and gross motor function, and sensory integration
Body Structure/ Function	Pediatric Clinical Test of Sensory Interaction for Balance (P-CTSIB) ²⁷⁰⁻²⁷²	4-10 years	Measures sensory system effects on stationary standing postural control (balance)	Six conditions: Standing on floor with eyes open, eyes closed, and with dome (eyes open, but vision stabilized); Standing on foam with eyes open, eyes closed, and with dome (eyes open, but vision stabilized)
Body Structure/ Function	Tests for hip joint integrity ²⁷⁴	Any age	Gross test to determine likelihood of dislocation	Ortolani's sign; Manual movement of the hip joint. With child in supine and hips and knees flexed to 90°; therapist places thumb on medial thigh and finger over greater trochanter and gently abducts hip. Will feel a clunk if hip is dislocated; Barlow's sign: With the child in supine and hips and knees flexed to 90°, therapist also observes for asymmetrical skin folds, limited hip abduction, and apparent shortening of one leg.
Body Structure/ Function	Leg length discrepancy ²⁷⁴	Any age	Clinical measure of leg length	Tape measurement from ASIS to medial malleoli while lying in supine.
Body Structure/ Function	Modified Ashworth Scale (MAS) ^{273,274}	4-5 years and older	Measures resistance to passive movement associated with spasticity	Passive movement of a limb through range while judging the resistance to the movement. Resistance is judged on an ordinal scale. Reliability of MAS in children is variable and should be used with caution.
Body Structure/ Function	Modified Tardieu Scale ²⁷⁵	4-5 years and older	Measures amount of joint range with passive movement and is associated with spasticity	Limb is moved quickly through the available range of motion and the joint position of initial resistance to passive movement is recorded as the first catch (RI) and then the limb is moved slowly to the end range (R2) and this joint position is also recorded.
Body Structure/ Function	Manual Muscle Test (MMT) ²⁷⁶	4-5 years and older	Provides information about muscle strength	Elicit contraction of muscles and if child is strong enough, apply manual resistance in gravity eliminated positions or against gravity. Strength is judged on an ordinal scale.
Body Structure/ Function	Energy Expenditure Index (EEI) ^{277,278}	3 years and older	Measures endurance level and can be used to monitor changes over time.	Calculation of heart rate (beats per minute) distance walked (meters) and time (minutes). EEI = Working HR - Resting Heart Rate-Speed. Normative values for self-selected and fast paced walking for children 5-15 years.
Body Structure/ Function	Six Minute Walk Test ²⁷⁹	5 years and older	Measures walking endurance and can be used to monitor change over time.	Distance walked in 6 minutes over level ground.
Body Structure/ Function	Functional Reach Test (FRT) ²⁸⁰⁻²⁸³	4 years and older	Measures anticipatory postural control when reaching from standing	Measurement of the distance that the child can reach forward from a stationary standing position. Normative values available.
Body Structure/ Function	Timed Up and Go (TUG) ²⁸⁴⁻²⁸⁶	4 years and older	Measures anticipatory standing balance, gait control, and motor function through a typical activity	Measurement of the time it takes to rise from a chair, walk 3 meters, turn around and return to a seated position in the chair.
Body Structure/ Function	Pediatric (Berg) Balance Test ²⁸⁷⁻²⁸⁹	5 years and older	Measures balance during movement activities	14 items including common movement activities such as sit to stand, transfers, picking an object up from the floor, and walking and turning.