Movement System Diagnosis in Neurologic Physical Therapy: Where Are We?

Movement System Task Force, Academy of Neurologic Physical Therapy
APTA Combined Sections Meeting 2017
San Antonio, TX

Movement System Task Force
Academy of Neurologic Physical Therapy

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Disclosure

Lori Quinn, EdD, PT, is author of *Documentation for Rehabilitation: A Guide to Clinical Decision Making in Physical Therapy* and receives royalty payments.

No other speaker disclosures regarding relevant financial relationships, conflicts of interest, or bias related to the content of this presentation.

Learning Objectives

1. Discuss the imperative for developing and adopting movement system diagnoses in neurologic physical therapist practice.
2. Describe key attributes of movement system diagnoses for neurologic physical therapist practice.
3. Apply one example of a standardized movement observation system to videotaped patient cases.
4. Discuss the implications for developing and adopting movement system diagnoses on neurologic physical therapist practice, education, and research.
5. Contribute to recommended next steps for the ANPT towards developing and adopting movement system diagnoses.

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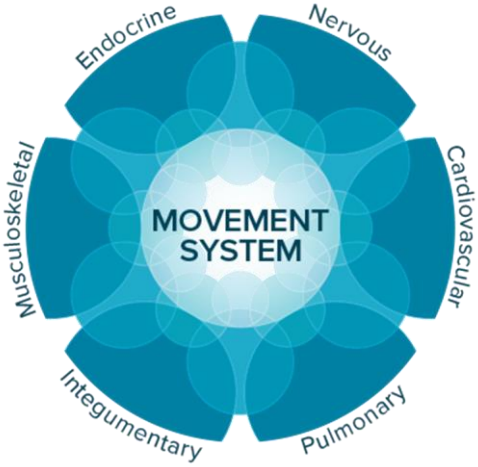
The Movement System and Neurologic Physical Therapy

Movement System Definition



The anatomic structures and physiologic functions that interact to move the body or its component parts.

Physical Therapist Practice and The Human Movement System White Paper, August 2015, American Physical Therapy Association.
Figure developed by the APTA Movement System Task Force. Used with permission.

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An Over 40-year Discussion

- Helen J. Hislop
- Steven J. Rose
- Jules M. Rothstein
- Cynthia A. Coffin-Zadai
- Shirley A. Sahrmann
- Alan M. Jette
- Andrew A. Guccione
- Barbara J. Norton
- Kathy J. Sullivan
- Nancy J. Zimny
- Paula M. Ludewig
- Edelle Field-Fote
- Ann VanSant
- Diagnosis Dialog Participants
- APTA Task Force I and II
- ANPT Task Force

The Case for Diagnosis

$$\text{Patient Value} = \frac{\text{Health Outcomes}}{\text{Cost}}$$

Michael Porter and Thomas Lee, The Strategy That Will Fix Health Care. Harvard Business Review, October 2013

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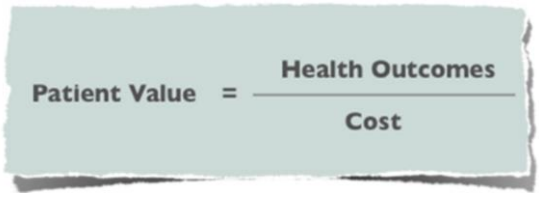
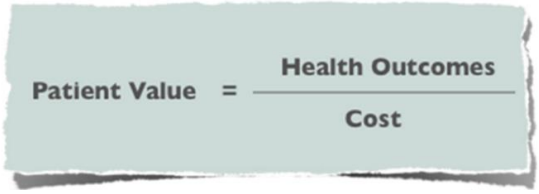
Health Outcomes



- Examination includes movement analysis of fundamental tasks
- Diagnosis is identified and labeled
- Intervention is targeted
- More consistency in practice

Cost



- Gains in efficiency
  - Pattern recognition
  - Reduced trial and error
- Care tailored to patient needs rather than blanket reduction in visits or length of stay

BODY OF PROOF

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ANPT Task Force

- Call for appointments in March 2015
- Convened in June 2015
- Literature review
- Face-to-face meeting in May 2016
- Poster at IV STEP
- Four members attended APTA Movement System Summit in December 2016
- White Paper
- Proposal for Phase II

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Is there a Diagnostic Manual for Movement System Problems?

What is Available?

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Process for Review of Literature

18 journal articles

15 **characteristics**

Reviewed articles and identified **characteristics**

Not prepared to offer a single diagnosis approach

4 **critical attributes** for developing approach

Examples of 4 **critical attributes**

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Succesful Movement System Diagnoses--Building the Manual

1. Based on sound, evidence-based theoretical framework(s).
2. Be applied to a wide variety of critical movement tasks that represent the major domains of motor control.
3. Emphasizes movement analysis of key tasks as central to the clinical examination, informs clinical reasoning and decision making, and culminates in a movement system diagnosis.
4. Provide unique and non-ambiguous labels for the diagnostic categories.

1. Based on sound, evidence-based theoretical framework(s).

- Operational definitions
- Theoretical constructs
- Measurement and outcome variables
- Predictable hypotheses

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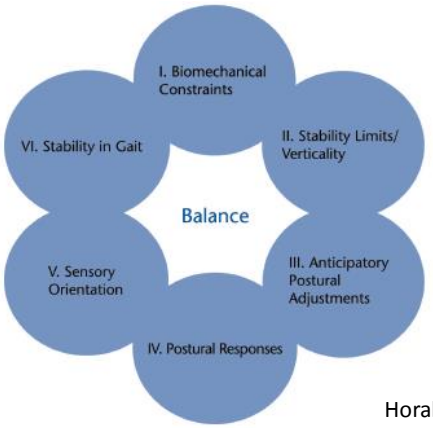
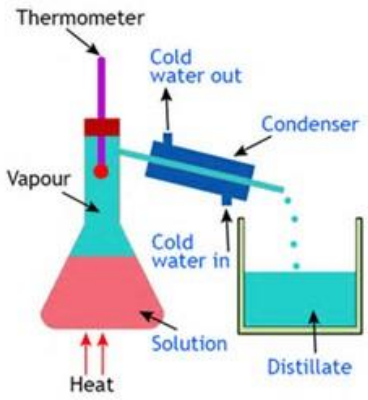
Example - Theoretical Framework



Horak et al. Phys Ther. 2009; 9(5):484–98.

2. Be applied to a wide variety of critical movement tasks that represent the major domains of motor control.

- Requires distillation of the essential diagnostic component, regardless of the task.



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Example – Variety of Tasks

Table 1. Classifications for physiotherapy patient management.

Classification	Description
A. Exercise capacity and performance	Absence of motor impairment or specific limitations in functional activities; potential for cognitive and/or behavioural issues
B. Planning and sequencing of tasks (including bradykinesia)	Presence of apraxia or impaired motor planning; slowness of movement and/or altered force generation capacity resulting in difficulty and slowness in performing functional activities
C. Mobility, balance and falls risk	Ambulatory for community and/or household distances; impairments in balance, strength or fatigue resulting in mobility limitations and increased falls risk
D. Secondary adaptive changes and deconditioning	Musculoskeletal and/or respiratory changes resulting in physical deconditioning, and subsequent decreased participation in daily living activities, or social/work environments
E. Abnormal posturing (seating and bed positioning)	Altered alignment due to adaptive changes, involuntary movement, muscle weakness and incoordination resulting in limitations in functional activities in sitting
F. Respiratory dysfunction	Impaired respiratory function and capacity; limited endurance; impaired airway clearance resulting in restrictions in functional activities and risk for infection
G. Palliative care	Active and passive range of motion limitations and poor active movement control resulting in inability to ambulate; dependent for most activities of daily living; difficulty maintaining upright sitting position

Quinn L and Busse M. Neurodegen Dis Mangage. 2012;2(1):1-11.

3. Include a clinical examination process that will provide a foundation for clinical reasoning/decision making, leading to a movement system diagnosis.

- **Some standardization of the clinical examination**
- **Performed in a consistent manner**
- **Guides the evaluation process**
- **Hypothesis generation**
- **Results in a label**

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Example – Clinical Examination

CASE STUDIES

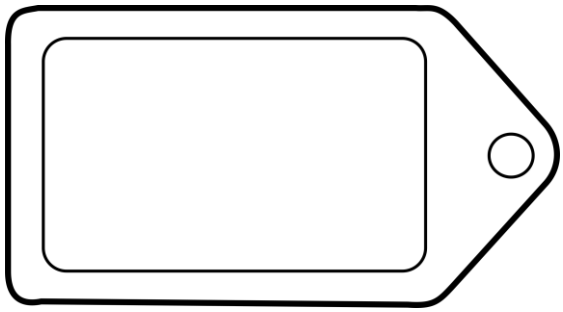
What Is Backward Disequilibrium and How Do I Treat it?: A Complex Patient Case Study

Patricia L. Scheets, PT, DPT, NCS, Shirley A. Sahrmann, PT, PhD, FAPTA, Barbara J. Norton, PT, PhD, FAPTA, Jennifer S. Stith, PT, PhD, LCSW, and Beth E. Crowner, PT, DPT, NCS, MPPA

J Neurol Phys Ther. 2015;39:119-126.

4. Provide unique and non-ambiguous labels for the diagnostic categories.

- Descriptive
- Not confusing
- New labels are expected
  - Need accompanying descriptions, examination findings, and differential diagnoses
- Will need to be learned



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Example – Labels

Table 1

Names and Descriptions of the Original and Modified Requirements for Bipedal Locomotion

Original Locomotor Requirements	Modified Locomotor Requirements
Name: Initiation Description: Planned transition from quiet standing to walking	Name: Initiation Description: Transition from quiet standing to walking
Name: Termination Description: Planned transition from walking to quiet standing	Name Termination Description: Termination from walking to quiet standing
Name: Rhythmical Limb Movement Description: Manifestation of core locomotor pattern	Name: Coordination of Rhythmical Stepping and Arm Swing Description: Reciprocal and symmetrical upper and lower extremity motion during walking

Hedman LD, Morris DM, Graham CL, et al. Phys Ther. 2014:94(1):52-67.

Recommendation

- Exert great efforts towards developing a set of movement system diagnoses that can meet most, if not all, of these attributes.

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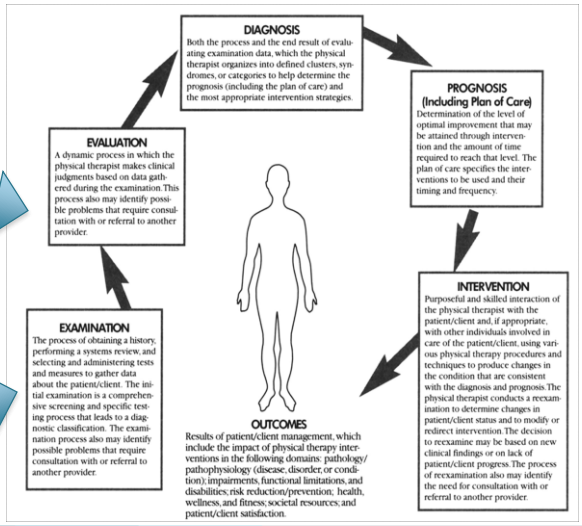
Implications of a Movement System Diagnosis in Neurologic Physical Therapy Practice, Education, and Research

Movement System Implications

Practice

Clinical Reasoning



http://www.apta.org/uploadedFiles/APTAorg/About_Us/Policies/Practice/DocumentationPatientClientManagement.pdf.

Clinical Reasoning - Examination

Guide to PT Practice:

- History
- Systems Review
- Tests & Measures of
  - Body structure/function
  - Activity
  - Participation

Missing Element:

Movement observation and analysis of tasks

- Why person is experiencing movement problem
- How the movement problem might be labeled
- Standardized approach

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Clinical Reasoning - Examination

- Movement Observation of Tasks
  - How should tasks be observed and analyzed?
  - ➡ **Focus on critical aspects of movement/task**
  - How should tasks be performed?
  - ➡ **Systematic manner – protocol and guidelines**
  - Which tasks for which patients?
  - ➡ **PT selects relevant tasks / Core set of tasks**

Clinical Reasoning - Examination

- Core Standardized Tasks:
  - Sitting
  - Standing
  - Sit to stand, Stand to Sit
  - Walking
  - Step Up/Down
  - Reach, Grasp and Manipulation

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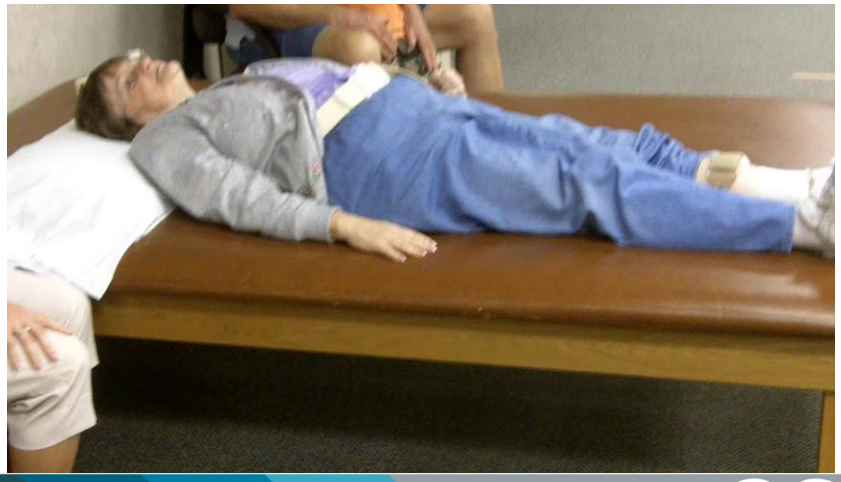
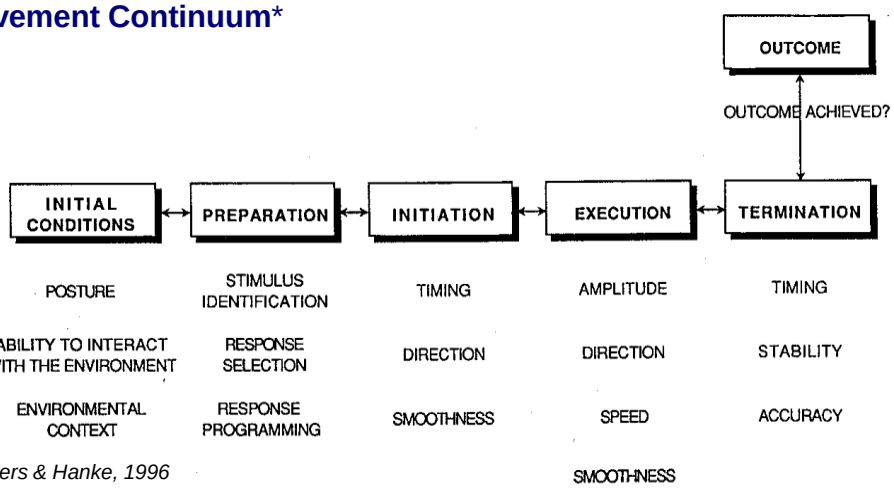
Case Example – Sit to Stand

Case Example – Rolling



Clinical Reasoning - Examination

Movement Continuum*



** Hedman, Rogers & Hanke, 1996*

Task: Sit to Stand*

- Initial Conditions:
  - No arm or back support
  - Surface height – level of TT
  - Buttocks at edge, feet on floor/even, hip width apart
- Initiation:
  - Pelvis tilts anteriorly & trunk accelerates forward via hip flexion
- Execution:
  - Buttocks lift off as weight transfers fully onto feet
  - Hips and knees extend simultaneously
- Termination:
  - Erect trunk, full hip & knee extension, minimal postural sway

* Bilateral symmetrical task

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Case Example Revisited - STS

- Initial Conditions:
  - No arm / back support
  - Surface height higher than TT
  - Buttocks not at edge, feet on floor/L AFO, hip width apart; pelvis posteriorly tilted, trunk flexed
- Initiation:
  - Minimal pelvic or trunk movement, little trunk acceleration or hip flex
  - Reaches R hand to mat, moves out of midline to the R
- Execution:
  - Buttocks lift off as knees extend into mat, weight shared between feet & support from mat
  - Hips and knees extend
  - More weight on R > L
- Termination:
  - Trunk almost erect, full hip & knee extension with support from mat, minimal postural sway
  - Stays shifted to R

Task: Step Up

- Initial Conditions:
  - Standing without support ~6” from a 4-6” step
  - Trunk erect; feet hip width apart
- Initiation:
  - Weight shifts to stance leg
- Execution:
  - HKA flexion of moving leg with placement of foot on step; stance leg in full hip and knee extension
- Execution
  - Slight additional HKA flexion to lift foot off of step followed by HK extension to place foot on floor
  - Weight shift to opposite leg, then repeat with opposite leg
  - Feet remain hip width, trunk erect
- Termination:
  - Erect trunk, both feet on the ground, minimal postural sway

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Case Example – Step Up Task

Clinical Reasoning - Evaluation

Diagnostic Process

"...define which elements of the movement system contribute to deficits in capacity or performance, and become the focus of the plan of care."*

Diagnostic Label (MSD)

"Pattern recognition" – analyze & match results of the clinical examination to ***known description of movement system problems.***

** www.apta.org, 2016*

Clinical Reasoning - Intervention

Movement System Diagnosis

Identify clearly the movement condition (problem) at which intervention is targeted

Subgroup patients so that evidence-based interventions can be selected for the specific movement problem(s)

Clinical Reasoning - Intervention

Movement System Diagnosis 1	• Intervention S • Intervention H, etc.
Movement System Diagnosis 2	• Intervention L • Intervention C, etc.

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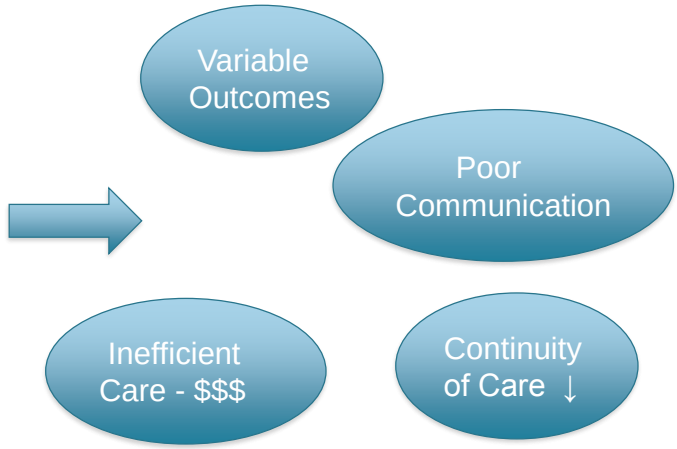
Unwarranted Variability in Practice

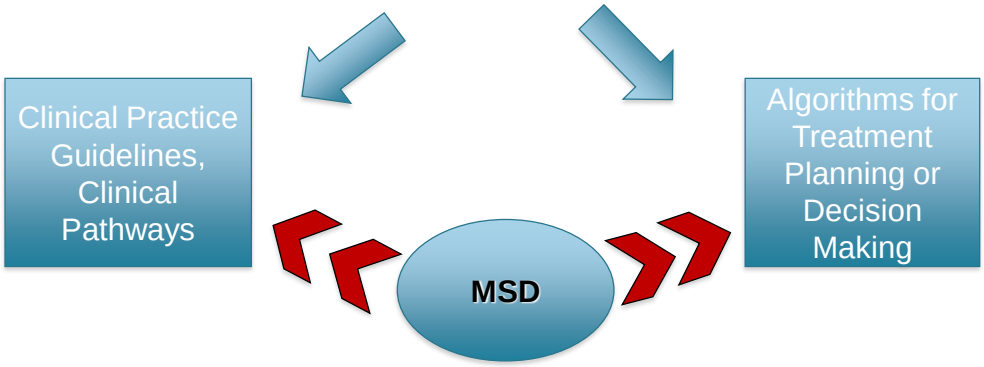
"Differences in care that cannot be explained by illness, medical need, or the dictates of evidence-based medicine."

Wennberg & Gittelsohn, 1973



Unwarranted Variability & MSD

More Consistency in Practice (EBP)



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Reimbursement & Coding

Current

Coding is driven by medical diagnosis

↓

Complexity, elements of care are not evident

↓

Data used to assess patient outcomes and reimbursement

Future

Coding sorted by MSD

↓

Complexity and elements of care more clearly reflected in billing codes

↓

Improved data used to assess outcomes and reimbursement

Documentation

- Movement System Diagnosis is best placed within the Assessment (*Evaluation/Diagnosis)* section of the Initial Examination.
- Examples……

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Documentation Example 1*

Pt. is a 46 y/o female who with an acute exacerbation of MS over last 2 weeks. Pt. presents with **movement system diagnosis of force production deficit** including LE weakness (L > R), impaired balance, fatigue, and limited PROM B hip abd and ankle DF. These problems have led to limitations in performing bed mobility, self-care, and ambulation. Pt. is at increased risk for falls due to postural control impairments and decreased symmetry and rhythmicity of gait. Pt. requires inpatient rehabilitation to address this recent decline in functional abilities and to assist patient in returning to prior functional level – independence in ADLs and community ambulation.

* Modified from *Quinn & Gordon, 2016*

Documentation Example 2*

Pt. is a 24 y.o. male 6 wk s/p BI with **primary diagnosis of motor planning deficit**. Pt. is impulsive, confused and easily agitated. He presents with memory deficits, difficulty learning new tasks, L-sided weakness and spasticity, all of which contribute to limitations in safe and independent bed mobility, self-care, transfers, ambulation, and wheelchair mobility.

Pt. also presents with **impaired anticipatory and reactive balance control**, which is the primary factor limiting ambulation.

Before injury, the patient was a FT student, lived with his family, and enjoyed active leisure activities. His residual cognitive and motor limitations have led to safety concerns, lack of independence in functional abilities and significant limitations in social, personal, and occupational life roles. Pt. requires intensive 1:1 6-days/wk BID physical therapy to address the above-stated impairments and activity limitations in light of his cognitive and behavioral deficits.

* Modified from *Quinn & Gordon, 2016*

Practice Recommendations

- Develop and implement a systematic process for movement observation and analysis of standardized tasks as a critical component of the patient examination.
- Define and validate Movement System Diagnoses (MSDs) with clear descriptions of the key examination findings associated with various movement system problems (pattern recognition).
- Link MSDs, once developed, to evidenced-based interventions though CPG, decision-making algorithms, search terms, etc.
- Integrate MSDs into coding, reimbursement and documentation.

Movement System Implications

Education

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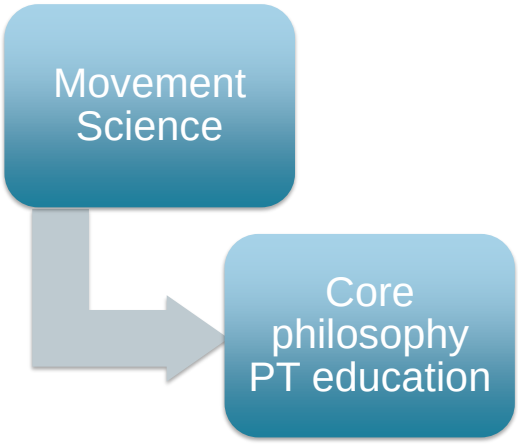
Education

Adoption of movement system as core philosophy for PT education - *Deusinger, 2016*

- Didactic & clinical entry-level
- Post professional training
  - Academic
  - Residencies
  - Fellowships
  - Continuing education



Education

Movement Science: the basis for concept based entry-level curricula

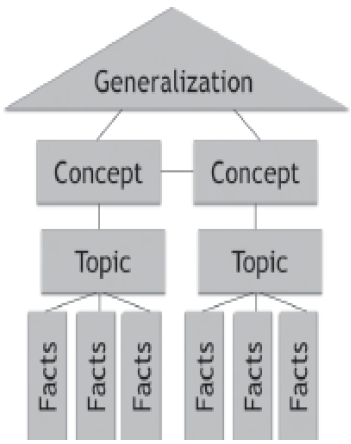


Figure 5: The Structure of Knowledge

Education

CAPTE criteria do not currently reflect human movement system as a fundamental concept

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Education

Needed:

Framework for clinical reasoning with human movement system at the center

Duesinger, 2016; Graham, 2015

https://www.apta.org/CAPTE/Verification.aspx?097112116097+108111103111+108111103111046112110103&G3Pwyt5fju%2fwUo1CWixv6vi%2fU%2fMrKdfzvzf0aidFqZrelm5M62xLDfMWhIrqs67ox6b09WVVdbxwkSvdF3LOJA%3d%3d

Education

Examples of movement science as entry-level curricular construct

- Caitlin, 1993
- Hedman, Rogers & Hanke, 1996

https://www.google.com/search?site=&tbm=isch&source=hp&biw=1225&bih=585&q=curriculum&oq=curriculum&gs_l=img.12...1727.4104.0.5713.0.0.0.0.0.0.0.0..0.0....0...1ac.1.64.img..0.0.0._9M4U2o3jP8#imgrc=BNLD4bMo-c6M1M:

Education

Current CAPTE diagnostic criteria: PT will “Determine a diagnosis that guides future patient/client management”

http://mappdom.com/businessopp

Education

Educate the Educators

- academic and clinical entry level faculty
- residency and fellowship faculty
- all clinicians

Education Recommendations

- Publish descriptions and presentations about human movement system based curricula
- Modify CAPTE criteria to reflect movement science as the core of PT curricula
- Profession wide mentoring for developing entry level curricula and ones that are transitioning their curricula
- Provide continuing education by the Academy of Neurologic Physical Therapy in which participation is both mandatory and offered at no cost

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Movement System Implications

Research

Research

Physical Therapy

The Revised Research Agenda for Physical Therapy FREE

Marc S. Goldstein ✉; David A. Scalzitti; Rebecca L. Craik; Sharon L. Dunn; Jean M. Irion; James Irrgang; Thubi H.A. Kolobe; Christine M. McDonough; Richard K. Shields

(2016) 91 (2): 165-174. **DOI:** https://doi.org/10.2522/ptj.20100248
Published: 24 October 2016 **Article history** ▾

- Develop and evaluate effective patient/client classification methods to optimize clinical decision making for physical therapist management of patients/clients.

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Research

NCMRR New Research Priorities include:

• To develop objective measures…that may predict rehabilitation treatment response, monitor functional progress, and tailor interventions to the individual abilities, needs, and resources of the person with disabilities.

The process of developing classification systems in neurologic rehabilitation

- Data-driven approach
- Experience-based approach

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Data-driven approach

- Utilizes large datasets to categorize patients based on movement-related and other problems
- Depends on standardized approach to assessment

Research Report

Descriptive Data Analysis Examining How Standardized Assessments Are Used to Guide Post–Acute Discharge Recommendations for Rehabilitation Services After Stroke

M.D. Bland, PT, DPT, NCS, MSCI, Program in Physical Therapy, Department of Neurology, and Program in Occupational Therapy, Washington University. Mailing address: Program in Physical Therapy, Washington University, 4444 Forest Park, Campus Box 8502, St Louis, MO 63108 (USA). Address all correspondence to Dr Bland at: blandm@wusm.wustl.edu.

Marghuretta D. Bland, Michelle Whitson, Hilary Harris, Jeff Edmiaston, Lisa Tabor Connor, Robert Fucetola, Alexandre Carter, Maurizio Corbetta, Catherine E. Lang

Bland et al. PTJ 2015

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Table 2.
Clinical Representation of Participants in Each of the 4 Clusters[a]

Cluster A	Cluster B	Cluster C	Cluster D
Impairment, Sensorimotor • Motor: full upper and lower extremity movement against gravity with moderate to maximal resistance • Sensation: light touch intact	**Impairment, Sensorimotor** • Motor: full upper and lower extremity movement against gravity, some able to take moderate resistance • Sensation: light touch intact and impaired	**Impairment, Sensorimotor** • Motor: upper and lower extremity movement but not full range of motion • Sensation: light touch intact and impaired	**Impairment, Sensorimotor** • Motor: limited upper and lower extremity movement • Sensation: light touch impaired
Impairment, Cognition • Dementia: not present • Neglect: not present	**Impairment, Cognition** • Dementia: minimal impairment • Neglect: minimal impairment	**Impairment, Cognition** • Dementia: moderate impairment • Neglect: minimal impairment	**Impairment, Cognition** • Dementia: major impairment • Neglect: major impairment
Impairment, Language • Not present	**Impairment, Language** • Minimal impairment	**Impairment, Language** • Moderate impairment	**Impairment, Language** • Major impairment
Activity • Basic ADL: modified independence or supervision • Balance: minimal to moderate impairment • Walking: ambulates at full community speeds	**Activity** • Basic ADL: minimal to moderate assistance • Balance: moderate to maximal impairment • Walking: unable to ambulate independently	**Activity** • Basic ADL: moderate to maximal assistance • Balance: major impairment • Walking: unable to ambulate independently	**Activity** • Basic ADL: maximal assistance • Balance: major impairment • Walking: unable to ambulate independently

[a] Clusters are described in general terms of some of the key impairment and activity limitation deficits. ADL=activities of daily living.

From: Descriptive Data Analysis Examining How Standardized Assessments Are Used to Guide Post–Acute Discharge Recommendations for Rehabilitation Services After Stroke

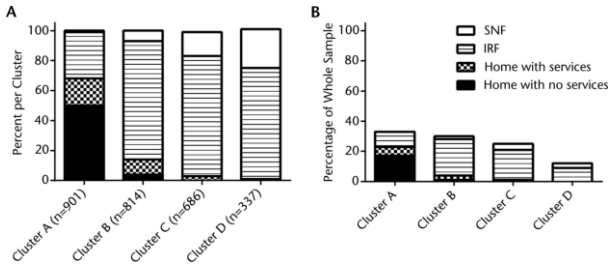

Figure Legend:
Recommendation for future rehabilitation services across all 4 clusters. (A) Summary of discharge recommendation as a percentage of each cluster. (B) Summary of discharge recommendation as a percentage of the whole sample. Discharge recommendations include: home without services, home with services, inpatient rehabilitation facility (IRF), or skilled nursing facility (SNF).

Experience-based approach

- Developed by expert-consensus and/or clinical experience
- Used to guide selection of interventions and develop common terminology for patient groupings

Focus on Diagnosis

Use of Movement System Diagnoses in the Management of Patients With Neuromuscular Conditions: A Multiple-Patient Case Report

Patricia L Scheets, Shirley A Sahrmann, Barbara J Norton

Example: Classification of movement system problems–across medical diagnoses

Developed 8 movement system diagnoses based on medical history, key tests and signs and associated signs.

EXAMPLE:
HYPOKINESIA The primary movement dysfunction is related to slowness in initiating and executing movement. May be associated with stopping of ongoing movement

Subjective/Medical History	Key Tests and Signs	Associated Signs
Associated Conditions: • Stroke • Seizure Disorder • Parkinson's Disease • Extra-pyramidal syndromes • Parkinsonism or Parkinson's Plus • Psychomotor Disadaptation Syndrome • Dementia • IVH • Seizure Disorder	Movement: • Able to move against gravity • Arrests in ongoing movement during functional tasks Postural Control: • Delayed timing of postural adjustments or absent postural adjustments in response to or in preparation of a movement • Loss of balance posteriorly • Inability to use appropriate postural control strategy in context Task Analysis: *Sit to Stand or Floor to Stand:* • Slow or lack of preparatory movement • Assistance with initiation • Loss of balance on termination • Unable to shift center of mass forward *Gait:* • Difficulty initiating ambulation	Muscle Tone: • Rigid with passive movement of U/LE and/or trunk Non-equilibrium Coordination: • Undershoots movement when aimed toward a target • Slowness or arrests in reciprocal movement Reflexes: • Delayed integration of early/primitive reflexes

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CONTINUUM **Review Article**

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Relationship Disclosure:
Dr Fasano serves as a speaker for Abbott Laboratories, Chiesi, Medtronic, Inc, and UCB, and receives research support from Afar and Medtronic, Inc. Dr. Bloem serves as a consultant for Boehringer Ingelheim and GlaxoSmithKline and receives research grants from Abbott Laboratories, GlaxoSmithKline, and Medtronic, Inc.

Unlabeled Use of

Gait Disorders

Alfonso Fasano, MD, PhD; Bastiaan R. Bloem, MD, PhD

ABSTRACT

Purpose of Review: This article provides insight and reviews useful tools for the clinical assessment, understanding, and management of neurologic gait disorders.
Recent Findings: In recent years, our understanding of the physiology of human walking has steadily increased. The recognition of gait as a complex, ''higher-order'' form of motor behavior with prominent influence of mental processes has been an important new insight, and the clinical implications of gait disorders are increasingly being recognized. Better classification schemes, the redefinition of established entities (eg, senile gait), and new insights from research on degenerative disorders primarily affecting gait (eg, primary progressive freezing of gait) have become available.

Example: Classification of gait disorders – across medical diagnoses

Gait features:

- Velocity
- Cadences
- Step length
- Asymmetry
- Step width
- Variability
- Arm swing
- Episodic features
- Additional features

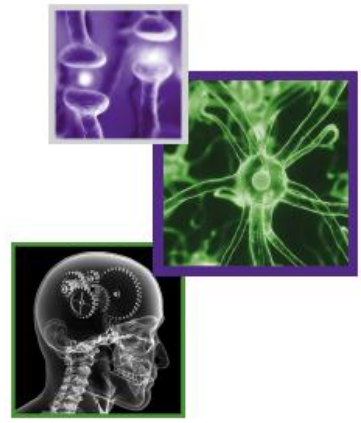
TABLE 8-3 The Pathophysiologic Classification of Gait Based on the Assessment Approach Described in This Article[a]

Gait	Compensation	Lower Limbs Feature	Velocity	Cadence	Step Length/ Height	Asymmetry
Antalgic	Pain	Limited range of movement	↓	↓	↓	↑↑
Cautious	Instability	None or locking of the knee	↓	↓	↓	↓↑
Higher-level gait disorder	Instability Dysexecutive syndrome Disorders of attention	(Rigidity)	↓/=	↓↑	↓	↓↑

SPECIAL REPORT

Physiotherapy clinical guidelines for Huntington's disease

Lori Quinn & Monica Busse; on behalf of the European Huntington's Disease Network Physiotherapy Working Group



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Example: Classifications of Movement System problems–disease-specific

Treatment-based classifications for Huntington's disease

Table 1. Classifications for physiotherapy patient management.

Classification	Description
A. Exercise capacity and performance	Absence of motor impairment or specific limitations in functional activities; potential for cognitive and/or behavioural issues
B. Planning and sequencing of tasks (including bradykinesia)	Presence of apraxia or impaired motor planning; slowness of movement and/or altered force generation capacity resulting in difficulty and slowness in performing functional activities
C. Mobility, balance and falls risk	Ambulatory for community and/or household distances; impairments in balance, strength or fatigue resulting in mobility limitations and increased falls risk
D. Secondary adaptive changes and deconditioning	Musculoskeletal and/or respiratory changes resulting in physical deconditioning, and subsequent decreased participation in daily living activities, or social/work environments
E. Abnormal posturing (seating and bed positioning)	Altered alignment due to adaptive changes, involuntary movement, muscle weakness and incoordination resulting in limitations in functional activities in sitting
F. Respiratory dysfunction	Impaired respiratory function and capacity; limited endurance; impaired airway clearance resulting in restrictions in functional activities and risk for infection
G. Palliative care	Active and passive range of motion limitations and poor active movement control resulting in inability to ambulate; dependent for most activities of daily living; difficulty maintaining upright sitting position

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C. Mobility, balance and falls risk.
Description: ambulatory for community and/or household distances; impairments in balance, strength or fatigue resulting in mobility limitations and increased falls risk; Stage: early–mid

Signs and symptoms/ key issues and potential issues	General aims	Treatment options
Participation: Fear of falling may result in more unwillingness to participate in home, work, and community activities; Difficulty in participating in recreational sports (e.g., cycling, running, soccer, basketball) that require balance and mobility **Activities:** Difficulty walking in certain environments (i.e., open environments); Difficulty walking backwards or sideways; Difficulty turning and changing directions; Difficulty getting in and out of chairs and beds due to vaulting, poor eccentric control; Difficulty with walking while doing a secondary cognitive task due to attentional deficits [43]; High falls risk [26,44] **Impairments:** ▪ Bradykinesia [45]; Dystonia – affecting trunk (lateral shift; extension), ankles/feet (inversion) [46]; Chorea†/rigidity [47–49]; Muscle weakness or	▪ Improve mobility status (increase independence; increase speed; increase distance walked) ▪ Reduce risk of falls or actual falls† ▪ Maintain independent mobility including transfers and walking for as long as possible	▪ Impairment exercises: strengthening; general conditioning; endurance; range of motion activity to counteract effects of dystonia; coordination exercises; teach strategies to help people with HD identify when fatigue would increase their risk of falls [58,59] ▪ Balance training to practice the maintenance of postural control in a variety of tasks and environments ▪ Train patients to step in response to perturbations in all directions with speed and accuracy ▪ Practice activities that require automatic responses (e.g., throwing ball) to elicit postural responses and train faster movements ▪ Progress activities from wide to narrow BOS, static to dynamic activities, low to high COG, increasing degrees of freedom ▪ Task-specific practice of functional activities such as transfers, reaching high and low, stair climbing, etc. to train balance control during ADL ▪ Task-specific training to address walking tasks, ideally in specific environments (e.g. outdoor; obstacles); external cueing [16,59,60] ▪ Use metronome [55,61,62], lines on floor to promote step initiation, bigger steps, faster speed, and gait symmetry

Research Recommendations

- Clinicians and researchers should collaborate to refine and further develop classifications.
- Development of classification systems both within and across medical diagnoses should be evaluated and tested for their clinical utility, including their ability to predict outcomes and responsiveness to intervention.
- Classification systems often incorporate both movement-related impairments in combination with activity limitations and we argue that bridging across levels of the ICF model can be helpful to the successful implementation of any approach.

Movement System Diagnosis & Neurologic Physical Therapy

Time for Discussion

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