PARKINSON'S DISEASE: WHY EXERCISE?

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DISCLOSURE

* I have no relationships with commercial interests.
* I have no conflicts to declare.
* I hereby certify that, to the best of my knowledge,
  no aspect of my current personal or professional situation might reasonably be expected to significantly affect my views on the subject I am presenting.

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WHY IS REHAB IMPORTANT IN PD?

- Learn how to slow down disease progression
- Benefit from putting off motor deterioration
- Improve symptoms (motor and nonmotor)
- Increase quality of life

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EXERCISE AND BRAIN CHANGE IN PD

Yesterday

Compensation

Bypass the deficits

Train stratgies to make everyday life simple

No challenge physical/cognitive effort

Today

Neuroplasticity

Forced use/beyond self selected effort

Start early

Maintain continuous threshold

Tomorrow

Exercise for life

New rehab paradigm

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OVERVIEW OF PARKINSONS DISEASE

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PREVALENCE (TOTAL NUMBER CURRENT CASES)

PD is the second most common neurodegenerative disease after Alzheimer's Disease

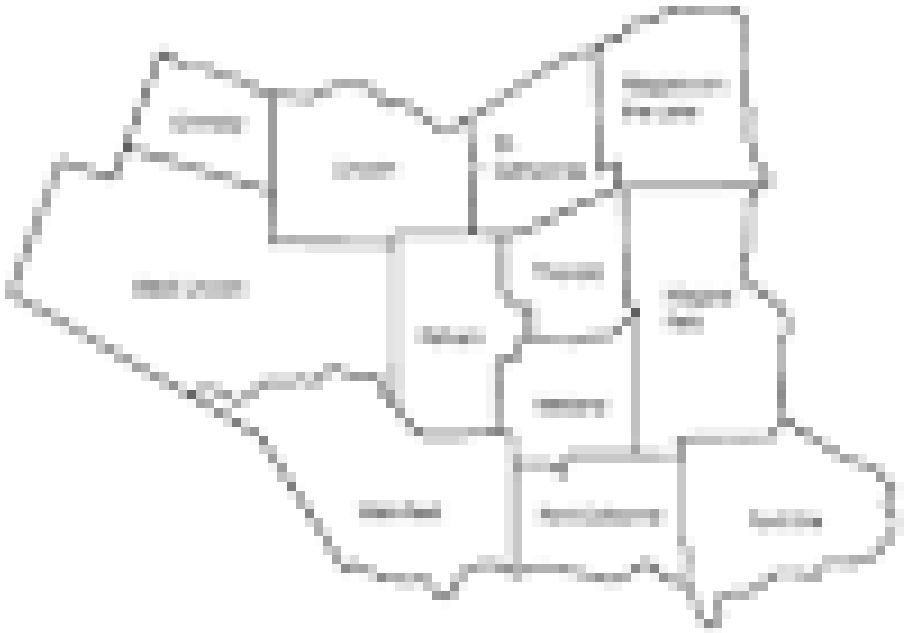
- 10 million worldwide
- Over 100 000 Canadians have PD
- 1 in every 500 people in Canada
- Rate increases with age >60 (1-3%)
- Men > Women (1.5 greater risk)
- 85% PwP are over 65 years
- 15% were diagnosed before 40 years
- 90:10 idiopathic: Hereditary
- 15-25% have a relative with PD

Lee A, Gilbert RM. Epidemiology of Parkinson Disease. Neurologic Clinics. Aug 2016

INCIDENCE (NEWLY DIAGNOSED PER YEAR)

14 – 25.6 per 100,000 per year

(Use higher estimates if greater number of people over 65 y in the region)



Total Population of Niagara: 447,888

Incidence of PD in Niagara: 62 – 116 /year (newly diagnosed)

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DIAGNOSTIC CRITERIA OF PARKINSON DISEASE

STEP 1

BRADYKINESIA: must be present! Slowness of initiation of voluntary movement with progressive reduction in speed and amplitude of repetitive actions.

And at least ***one*** of the following:

- Muscular rigidity
- Resting tremor
- Postural instability not caused by primary visual, vestibular, cerebellar or proprioceptive dysfunction

https://youtu.be/TNB2oAAMEyg

The Lancet Neurology May 2016; Postuma et al. MDS 2015.

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DIAGNOSTIC CRITERIA OF PARKINSON DISEASE

STEP 2: EXCLUSION CRITERIA

- Repeated strokes
- Repeated ABIs
- Prior definite encephalitis
- Oculogyric crises
- Neuroleptic treatment at symptom onset
- >1 affected relative
- Sustained remission
- Strictly unilateral features after 3 years
- Supranuclear palsy
- Cerebellar signs
- Early severe autonomic involvement
- Early severe dementia with disturbances of memory, language and praxis
- Babinski signs
- Presence of cerebral tumor or communicating hydrocephalus on CT Scan
- Negative response to large levadopa doses

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DIAGNOSTIC CRITERIA OF PARKINSON DISEASE

STEP 3: POSITIVE CRITERIA

In combination with Step 1 & 2 –

3 or more are required for a diagnosis:

- Unilateral onset (insiduous)
- Rest tremor present
- Progressive disorder
- Persistent asymmetry affecting side of onset
- Excellent response (70-100%) to levadopa
- Severe levodopa-induced chorea (dyskinesias)
- Levodopa response for 5 years or more
- Clinical course of > 10 years

Parkinson Tool Kit: UK Parkinson's Disease Society Brain Bank Centre Criteria

www.parkinson.org

(Hughes AJ et al. J Neurol Neurosurg Psychiatry 1992: 55:181-4.

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COMMON INITIAL PRESENTATION

SPECIFIC SYMPTOMS

- Resting tremor
- Micrographia/clumsy hands
- Lack of arm swing with gait
- Dragging the foot when walking or driving
- Slowness with gait/ADLs (with stress, fatigue, cognitive load)
- Voice changes (hypophonia)
- Difficulty maneuvering in bed

NONSPECIFIC COMPLAINTS

- Generalized stiffness
- Pain (shoulder, neck)
- Weakness
- Fatigue
- Mild incoordination
- Falling (22% report falls at DX!)
- Withdrawn from participation
- Reduced overall endurance
- Loss of confidence

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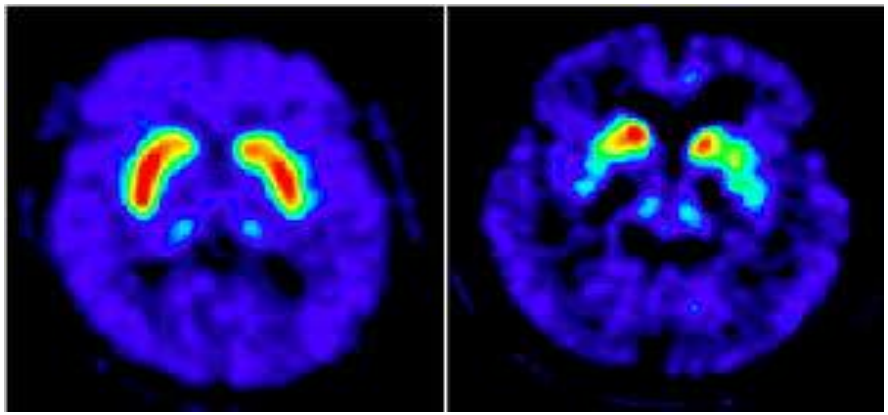
HOW DOES PARKINSONS DISEASE AFFECT THE BRAIN?

Fact: once physical signs become present, the substantia nigra region of the brain has lost 80% of its dopaminergic neurons.



Red/yellow regions indicate dopamine concentration.

Normal

Parkinson Disease

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WHAT ARE THE FUNCTIONS OF THE BASAL GANGLIA?

1. Control of reflex muscle activity
2. Control of muscle tone
3. Role in arousal mechanism
4. Role in emotions and learning

ROLE OF DOPAMINE: chemical is the brain that plays a role in many basic functions of the brain, such as *motor co-ordination*, *reward*, and *memory*.

It works as a signaling molecule – a way for brain cells to communicate with each other

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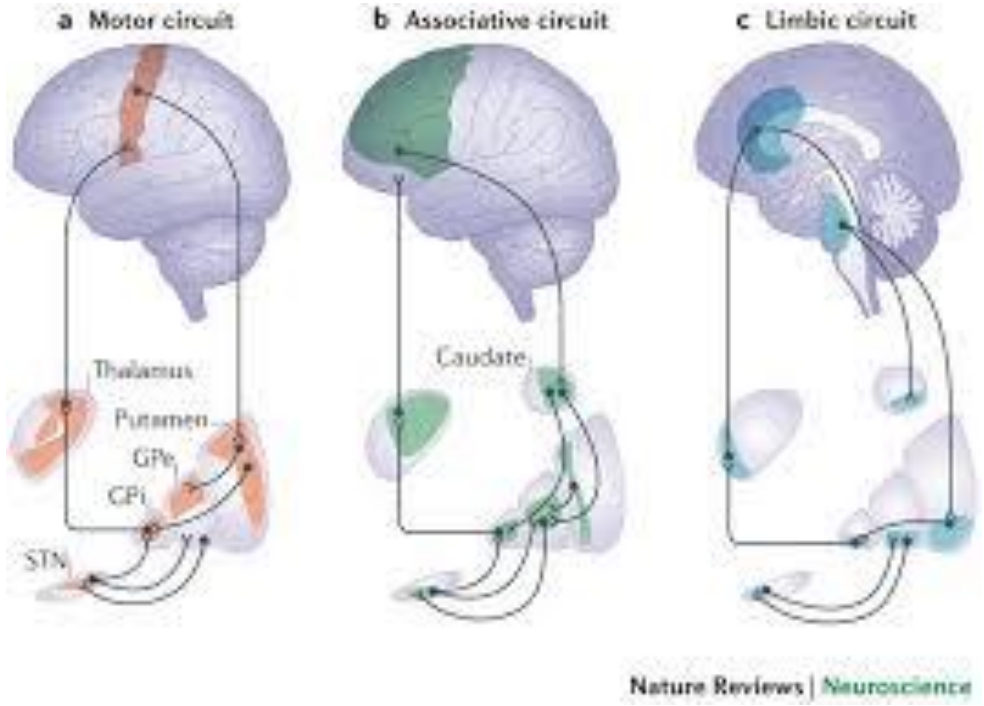
BASAL GANGLIA CIRCUITS



Motor: Bradykinesia, tremor, rigidity

Associative: Executive function, Attentional deficits

Limbic: Depression, anxiety, apathy

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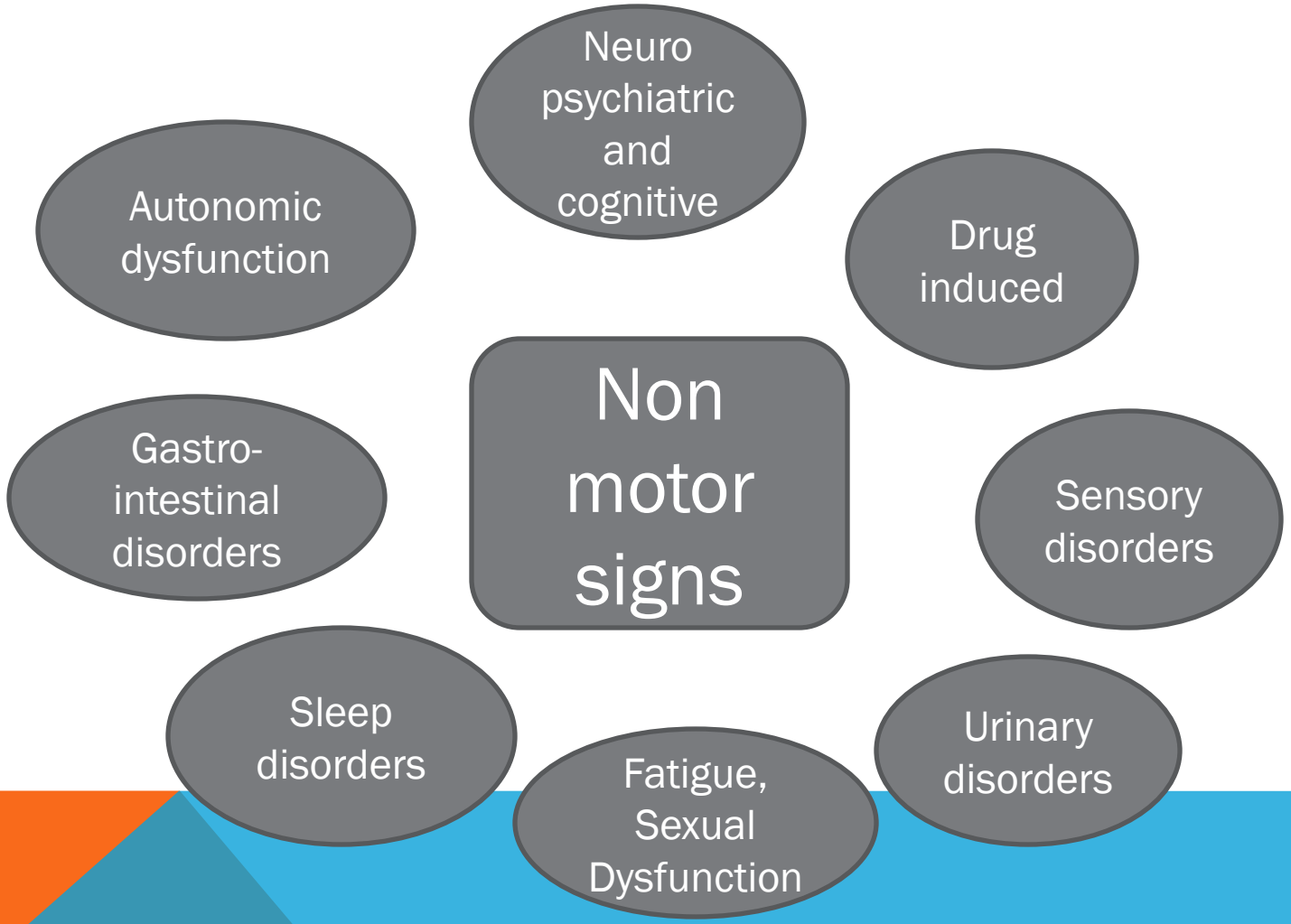
COMPLEXITY OF THE NON MOTOR SIGNS PD



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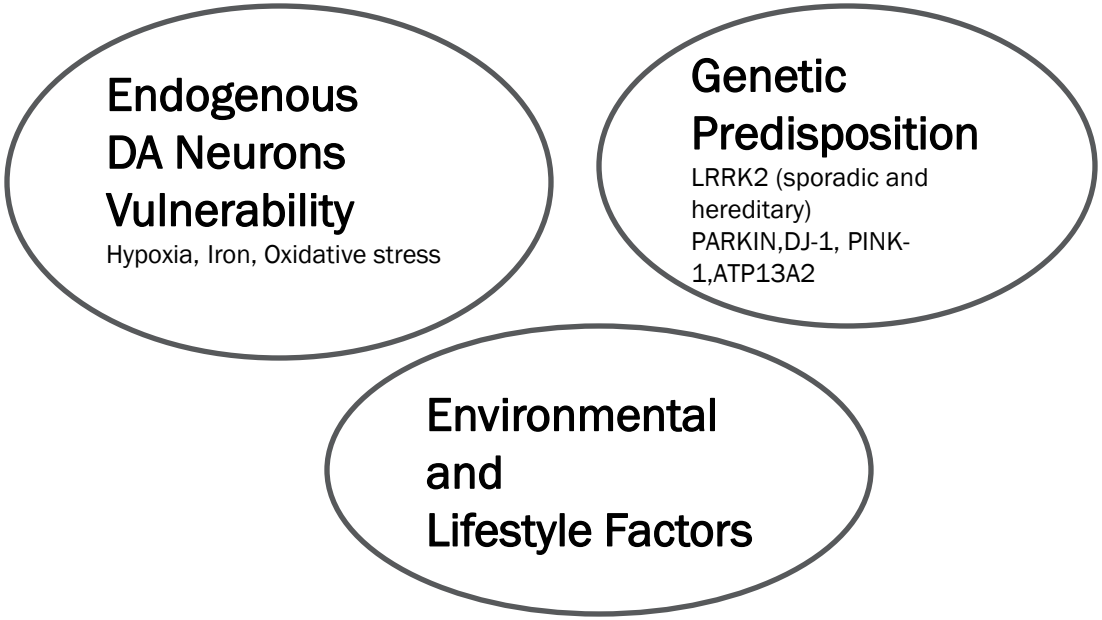
WHAT CAUSES PARKINSON'S DISEASE?

Accumulative Events and Factors Set off a Cascade of Cellular Mechanisms that Eventually Trigger Cell Death



15% familial
85% Sporadic
5% Monogenic

RESULTS: CELL DEATH

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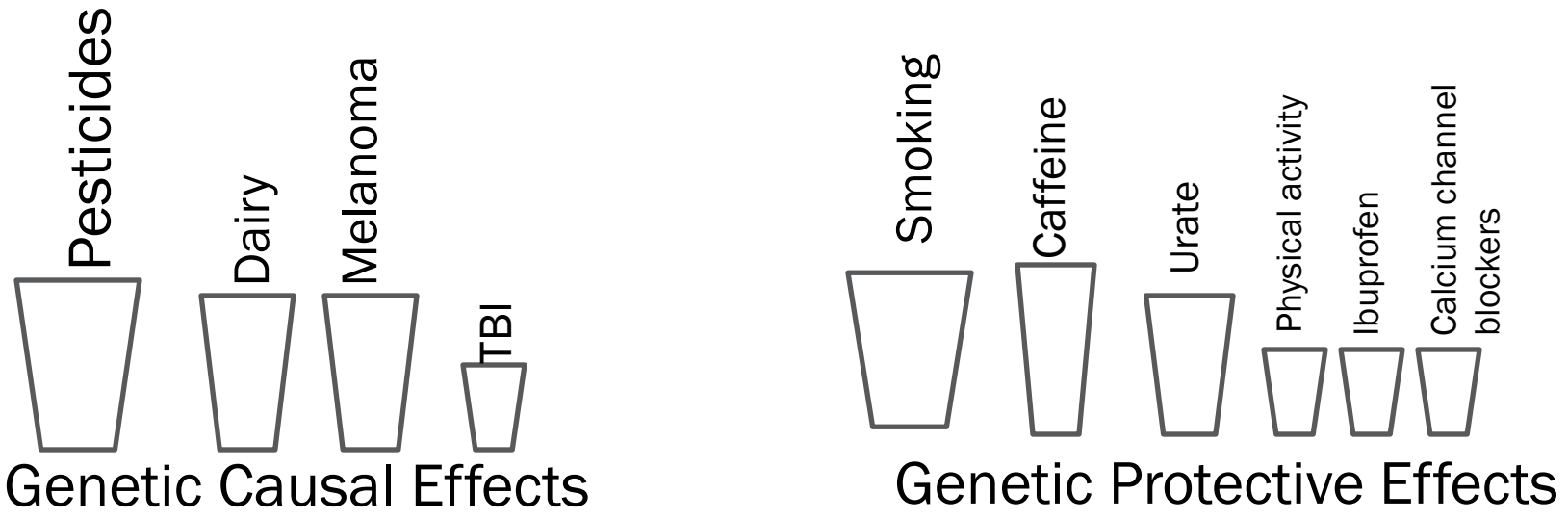
ENVIRONMENTAL AND BEHAVIOURAL RISK AND PROTECTIVE FACTORS FOR PARKINSON'S DISEASE



Ascherio, A., Schwarzschild MA. The epidemiology of Parkinson's Disease: risk factors and Prevention. LANCET 2017.; 1592: 1257-1272.

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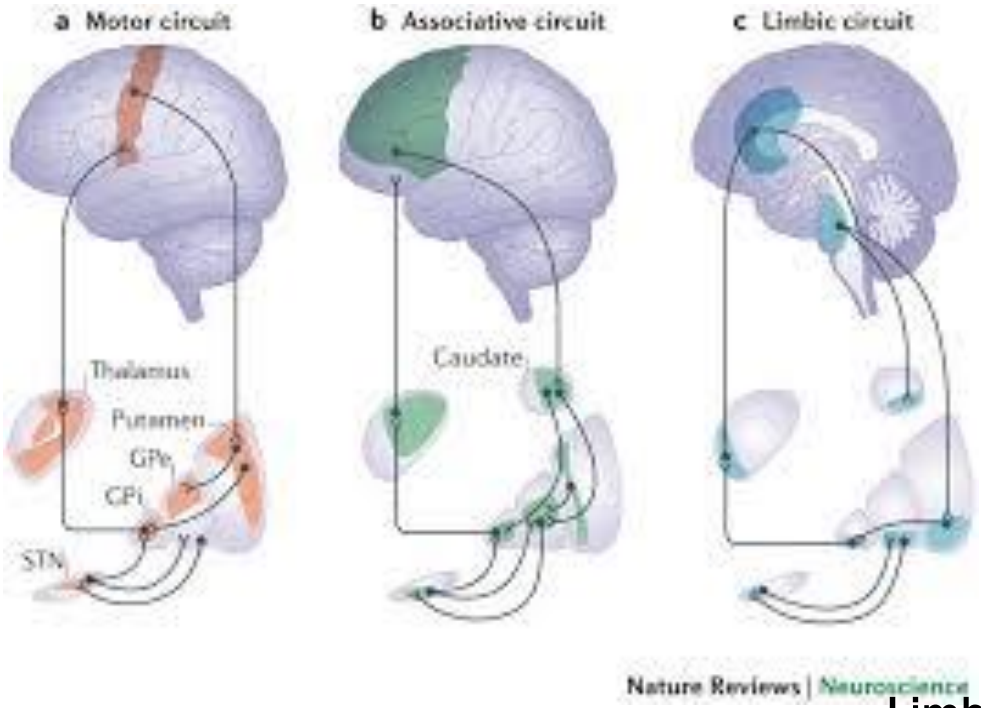
MULTIPLE PARALLEL CIRCUITS THROUGH THE BASAL GANGLIA CONTRIBUTE TO THE ABILITY TO MOVE AND RE-LEARN



Motor: Bradykinesia, tremor, rigidity

Associative: Executive function, Attentional deficits

Limbic: Depression, anxiety, apathy

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MOTOR SYMPTOMS OF PD

- **Bradykinesia**
  - slow/small movements and postural responses
  - Speed and amplitude dysregulation across motor systems
- **Rigidity**
  - cocontraction/stiffness (masking)
  - loss of axial/spinal mobility
  - postural deformities
- **Tremor (resting)**
- **Postural instability**
- **Impaired kinesthesia**

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COGNITION: CHANGES IN EXECUTIVE FUNCTION

- Attention
  - Sustained
  - Dual task (divided)
- Working memory
  - Updating/monitoring
  - Holding onto relevant task information while doing that task.
- Set switching
  - Ability to shift between tasks (prone to supine; STS-walk-turn) or rules (alternate numbers and letters; food and drink).
  - Adapting to changes in the environment
    - Transitioning surfaces
    - Changes in direction
- Response Inhibition
  - Switching between tasks requires prioritizing the most important task (or inhibiting the irrelevant ones)!

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EMOTIONAL DYSFUNCTION IN PARKINSON'S DISEASE

- **Apathy**
  - 17-20% - lack of motivation, loss of interest and spontaneity, blunted emotional experience.
- **Depression**
  - 40-50%. Manifests as pessimism and feeling of hopelessness.
- **Anxiety**
  - 69%. Apprehensiveness, nervousness, irritability, and feelings of impending disaster (palpitations, hyperventilation, insomnia)

Precedes diagnosis is 30 % of those diagnosed with PD

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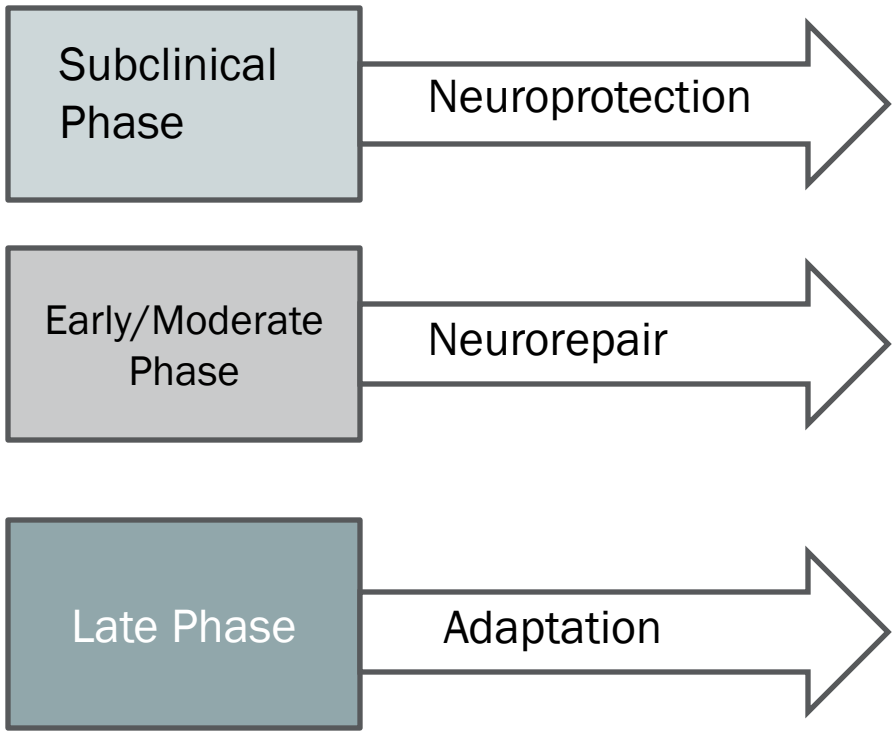
EXERCISE AS MEDICINE: FOR PARKINSON'S DISEASE



Tilerson et al. 2001; 2001; 2002; 2003
Zigmond et al., 2012; 2014
Mabandia and Russell 2004; 2010
Yoon et al., 2007

Fisher et al., 2004
Petzinger et al., 2006; 2007

Al-Jarrah et al., 2007, 2011; 2013
Pothakos et al. 2009

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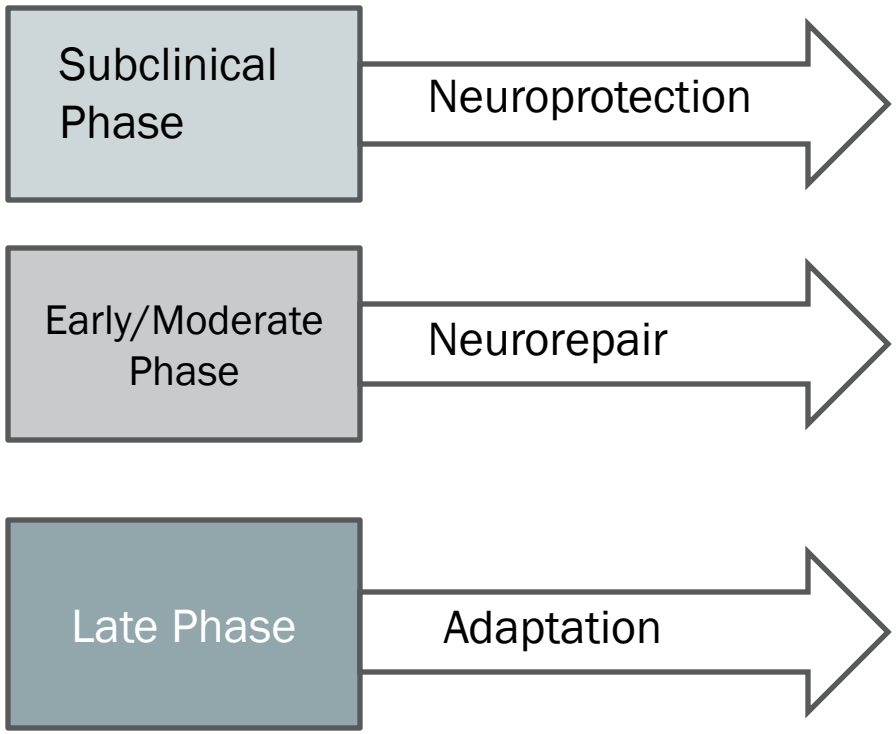
EXERCISE AS MEDICINE: FOR PARKINSON'S DISEASE



Protects and rescues vulnerable neurons

- Sustain/increase dopamine function

Enhance recovery or recruitment Of damaged circuits:

- Shunts dopamine where needed
- Improves signal
- Increases dopamine receptors

Recruit undamaged brain areas

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WHY IS EXERCISE SO IMPORTANT??

Exercise optimizes brain health and efficiency.

1. Subclinical

- Protects and rescues vulnerable neurons
  - Sustains/increases dopamine function

2. Early/Moderate

- Enhance recovery or recruitment of damaged circuits
  - Shunts dopamine where needed
  - Improves signal
  - Increases dopamine receptors

3. Advanced

- Recruit undamaged areas
  - Do more with less

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IMPLICATIONS TO EXERCISE: PARKINSON'S DISEASE!

- **Timing matters**
  - Early is better than later
  - Its never too late
- **Intensity matters**
  - Forced use – beyond self selected effort
  - Intermittent bouts/intervals vs. continuous
  - Vigorous aerobic training
- **Specificity matters**
  - Drive vulnerable damaged dopamine circuits
  - "Use it or lose it" ….. Consider "use it and improve it"
- **Continuous matters**
  - Threshold of exercise required to sustain

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EVIDENCE FOR NEUROPROTECTION IN PEOPLE WITH PD (PWP): EPIDEMIOLOGICAL, ANECDOTAL & EXPERIMENTAL

Regular, moderate to vigorous exercise in midlife lowers risk for developing PD

In PWP:

- Exercise increases survival rate
- Higher cognitive scores associated with greater physical fitness
- Regular exercise reduces the severity of motor/nonmotor symptoms
- Improves function with 3-6 month retention

Hamer and Chida 2009; Thacker et al., 2008; Xu et al., 2010; Chen et al., 2005; Hale et al., 2008; Gray et al., 2009; Bilowit 1956; Sasco et al., 1992; Palmer et al., 1986; Archer et al., 2011; Reuter et al., 2011.

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IMPLICATIONS OF "BRAIN CHANGE": EXERCISE AND PD

Neuroprotective: slow disease progression

Remains unknown if it spares or rescues or rejuvenates vulnerable dopamine neurons.

Neurorepair: slow motor deterioration/disability

Does it normalize or reorganize abnormal dopamine neural circuits?

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EARLIER EXERCISES DO BETTER!!!!!!!

Change in QUALITY OF LIFE ON PDQ-36 Score from Baseline

Do you exercise at least 2.5 hours/week?

Reported Exercise: Baseline/1-yr/2-yr	1- Year PDQ	2- Year PDQ
YES/YES/YES	0	1.8
NO/YES/YES	0.7	1.3
NO/NO/YES	2.4	3.5
NO/NO/NO	3.4	6.2

Higher # = worse QOL

- Database of 3000 patients who started exercising at different times
- No matter when patients started exercise, they CAN benefit

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EXERCISE AS MEDICINE

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WHAT YOU DO IS IMPORTANT!!!!

Progressive Aerobic Training

- **Intensity:** beyond self-selected

WHY: Brain health and Brain protection

Skill Acquisition

- PD specific skills
- PWR!Moves ®

WHY: Reinforce *dopamine* circuits

Promotes:

Brain Repair

Brain Adaptation

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AEROBIC EXERCISE FOR INCREASED PHYSICAL CAPACITY

- Maintain and prevent deconditioning
- Improves fitness (VO2max; endurance)[1,2,3]
- Increases gait speed
- Low intensity as effective in deconditioned subjects[1,2]

[1] Shulman et al., 2012
[2] Uc et al., 2014
[3] Schenkman et al., 2012

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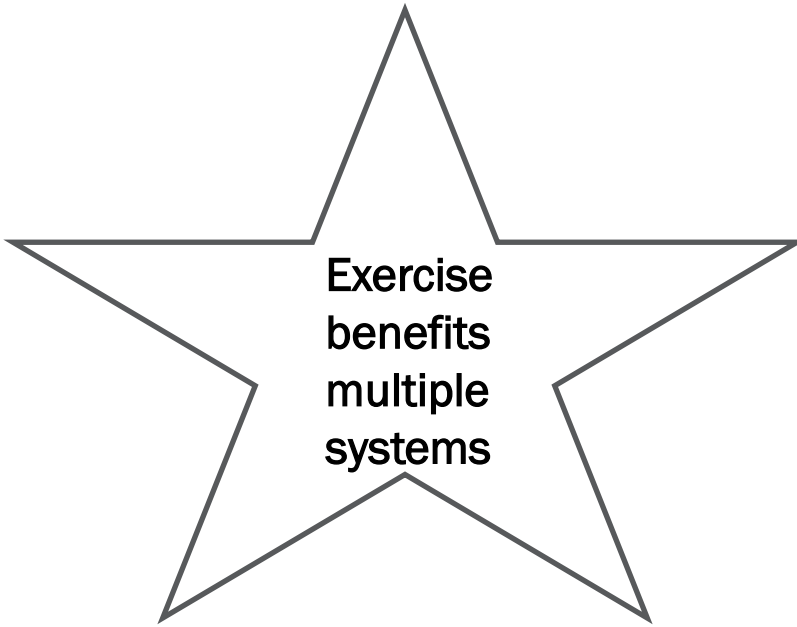
POTENTIAL MOTOR/NONMOTOR TARGETS OF PROGRESSIVE AEROBIC EXERCISE

Speelman, AD et al., Nature Reviews Clinical Neurology 7, 528-534 (September 2011)

- Prevention of cardiovascular complications
- Arrest of osteoporosis
- Improved cognitive function
- Prevention of depression
- Improved sleep
- Decreased constipation
- Decreased fatigue
- Improved functional motor performance
- Improved drug efficacy
- Optimization of the dopaminergic system



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AEROBIC EXERCISE: PROVES TO IMPROVE

- Improved language function
  - Fluency
- Improved dual task performance (both tasks improved)
  - 2MWT/serial subtraction
  - Cycling with fluency
  - Digit span : forward and backward
  - Functional Gait Assessment Items
- Improved executive function
  - Stroops/Trail Making related to verbal fluency
  - Spatial working memory
  - Mental flexibility
  - MOCA scores
  - PD cognitive rating scales
- Improved mood/quality of life

Cruise et al., Acta Neurol Scand 2011; Tanaka et al., Brain Cog 2009; Nocera JR et al., NeuroCase; Tabak R, Aquije G, Fisher B JNPT 2013.

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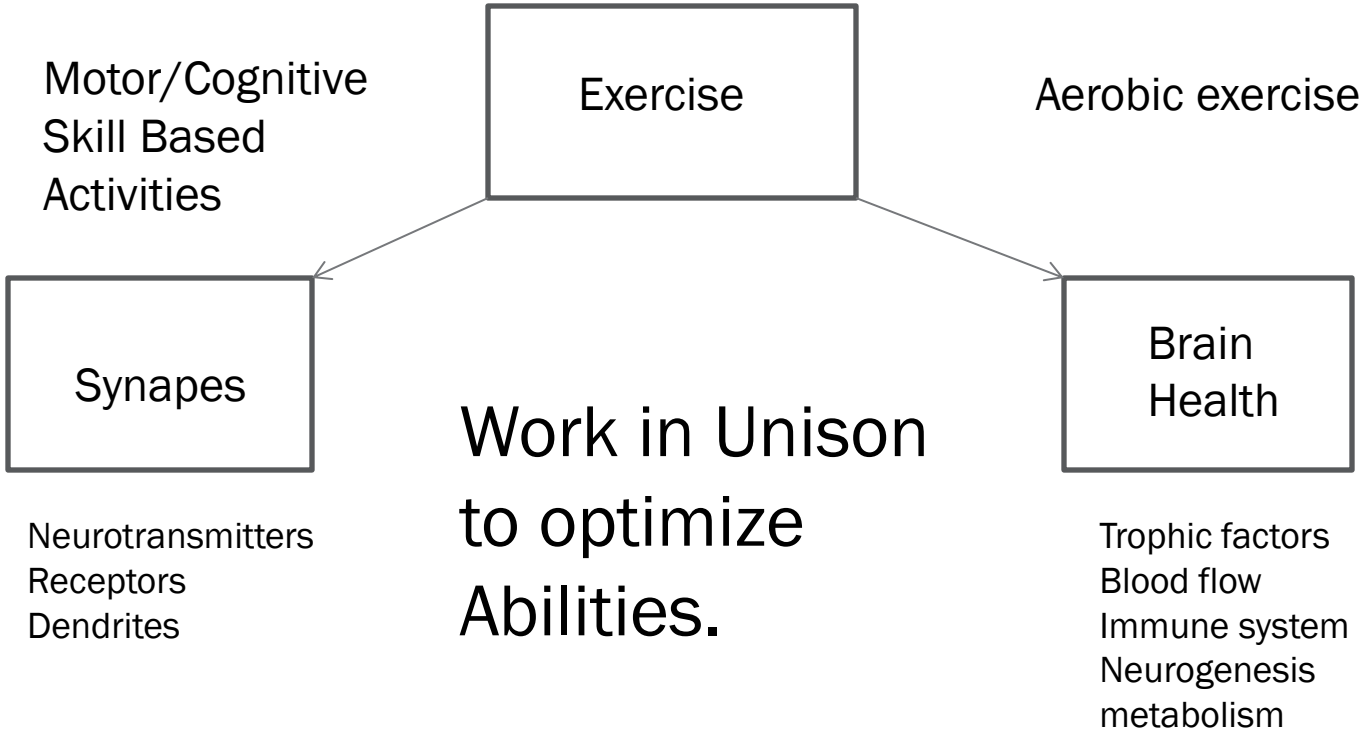
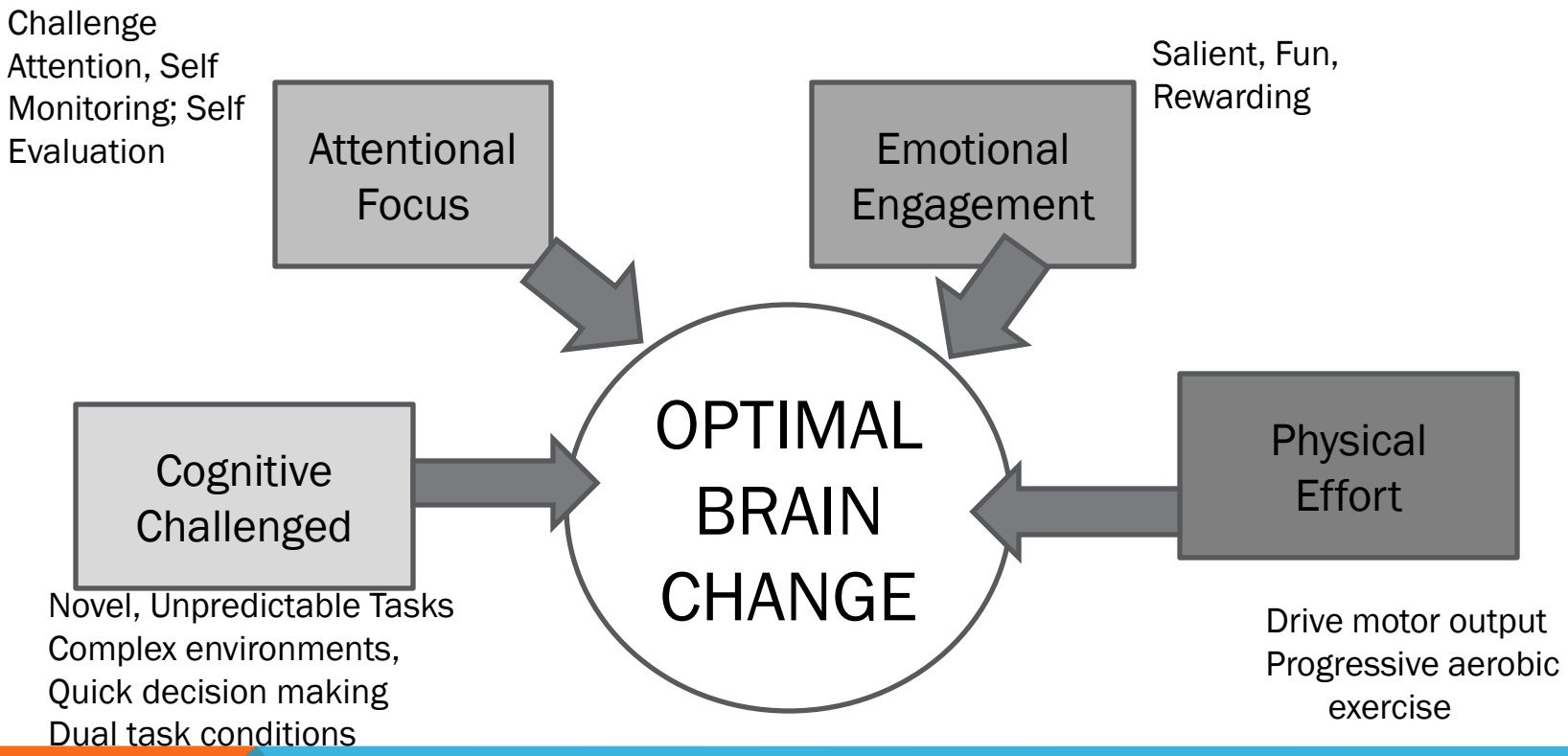
AEROBIC EXERCISE ENHANCES SKILL ACQUISITION CIRCUITRY : "NEURAL PRIMING EFFECT"



Exercise enhanced neuroplasticity targeting motor and cognitive circuitry in Parkinson's Disease GM Petzinger et al., Lancet Neurol 2013; 12:716-726

Engaging cognitive circuits to promote motor recovery in degenerative disorders. Exercise is a learning Modality. MW Jakowec et al., Human Kinestics 2016; 52: 35-51

HOW YOU PRACTICE IS IMPORTANT!!!
EXERCISE4BRAINCHANGE ® ESSENTIALS



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IF HOW YOU PRACTICE IS IMPORTANT: LET'S MAKE IT PD-SPECIFIC

Reinforce and enhance dopamine circuitry

Mechanism: Brain Repair/Adaptation

USE IT OR LOSE IT; USE IT AND IMPROVE IT

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PD-SPECIFIC SKILL ACQUISITION: PWR!MOVES®

Functionally based

BIG/FAST (Amplitude based)

Whole Body Movements

Functional Deficit Targeted	Basic 4 PWR!MOVES ®
Antigravity Extension	PWR! Up (posture/alignment)
Weight shifting	PWR! Rock (weight shifting)
Axial Mobility	PWR! Twist (trunk rotation)
Transitions	PWR! Step (transition)

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EVIDENCE4BRAIN CHANGE: PD-SPECIFIC APPROACH

Physical Effort	Attentional Focus	Cognitive Engagement	Emotional Engagement
Progressively challenge difficulty- beyond self selected effort • Posture • Neural priming (cardio) • Augment sensory • Bigger/faster whole body movement • Drive motor output across motor systems (Breath/Hands/Eyes/Voice) • Increase resistance/ effort/repetition/ accuracy/symmetry	Train sustained/divided attention on the **self – monitoring** of optimal function • Draw attention to action • Engage in the planning and problem solving process • Teach accountability for self monitoring and correction • Feedback! Reinforce best trial, performance, effort • Mental imagery • Remove external cues • Reduce reliance on vision	Progressively challenge complexity of movement • Add common dual tasks • Create/vary sequences of PWR!Moves that mimic function/ADLS • Vary patterns of bilateral coordination • Add additional cognitive/motor tasks • Vary predictability (time, distance, direction) • Alter environmental distractions	Augment internal/ external motivation to supplement for loss of dopamine • Group social structure • Reward! Reinforce! • Saliency. Practice meaningful personal activities that have relevance for life! • Empower with what they CAN do • Give feedback about goal achievement • Creativity; self expression • Set personal goals • Create AHA!! Moments of success

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Let’s try is together!!

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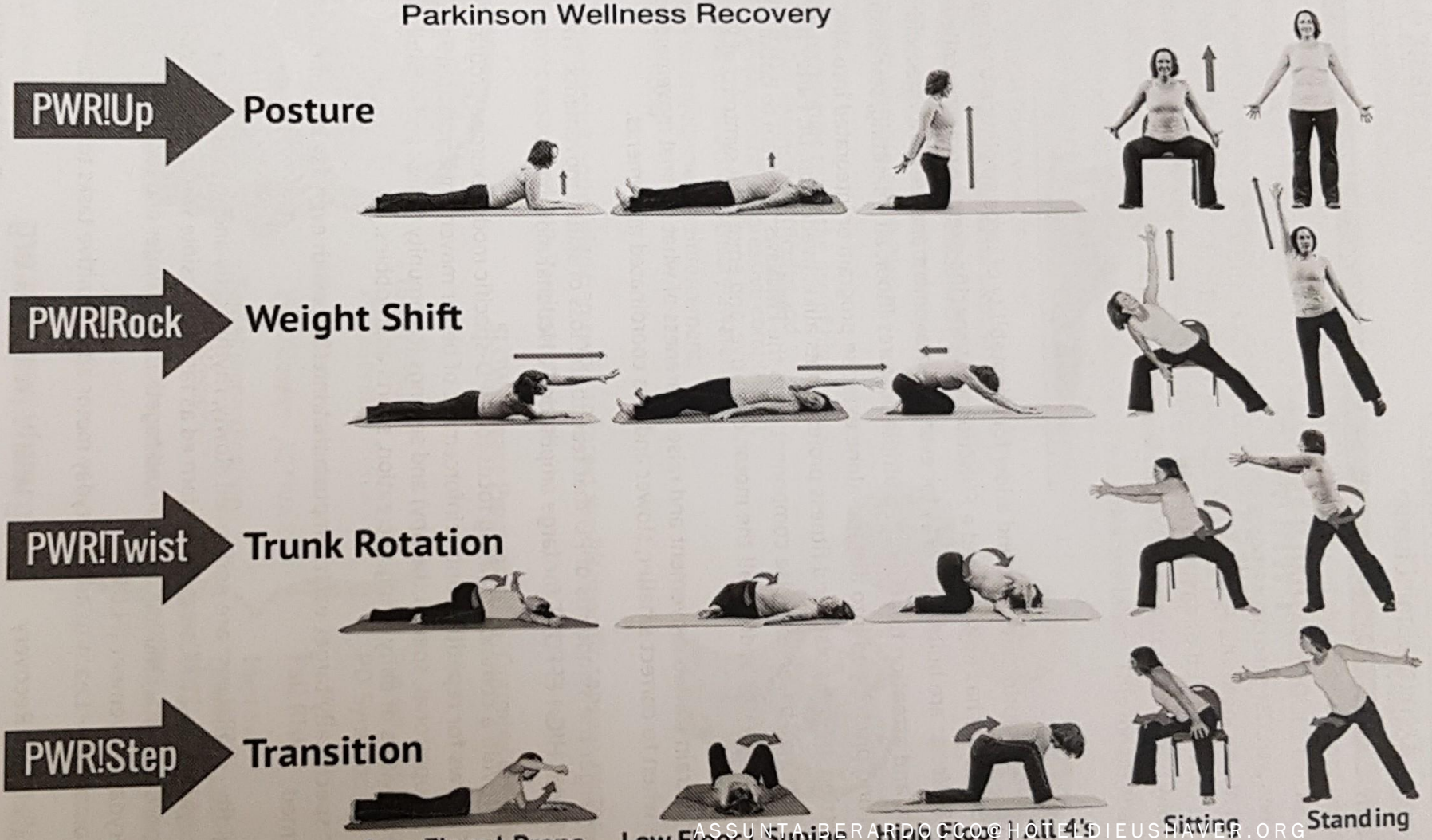
PWR!Moves® At a Glance

Parkinson Wellness Recovery



If it doesn’t challenge you,

It doesn’t change you

Fred DeVito

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