

International Guidelines on Interventions for Children with Cerebral Palsy

“State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children with Cerebral Palsy”

Novak I, Morgan C, Fahey M, Finch-Edmondson M, Galea C, Hines A, Langdon K, McNamara M, Paton M, Popat H, Shore B, Khamis A, Stanton E, Finemore OP, Tricks A, Velde A, Dark L, Morton N, Badawi N. *Current Neurology and Neuroscience Reports* 2020; 20:1-21.

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Reviewers: Yvette R. Johnson, Leslie-Anne Dietrich, Kristine Tolentino-Plata



Introduction

- **The rate of non-ambulant cerebral palsy has decreased by 30% in several high income countries**
 - Improvements in obstetric and neonatal care
 - Use of evidence-based interventions for cerebral palsy play a significant role in improving functional outcomes among children with cerebral palsy
- **Objective:**
 - To systematically describe the best available evidence for cerebral palsy intervention in 2019
 - This is an update from the previous international guidelines published in 2013
- **Review process:**
 - Updated **GRADE** system and the **Evidence Alert Traffic Light System**



Introduction

- **Purpose:**
 - **To describe what treatments have demonstrated evidence and highlight areas for more research**
 - Inform decision-making by describing effective, emergent, and ineffective care
 - Aid comparative clinical decision-making about alike interventions and indications
 - Provide a comprehensive resource to aid the creation of knowledge translation tools to promote evidence-based implementation
- **Study design:**
 - Systematic review of best available evidence
 - Included studies about interventions for children with CP or at risk
- **Search strategy:** (March-July 2019)
 - Used methods based on Cochrane collaboration and PRISMA statement
 - Systematic reviews preferred (with newer evidence)
 - Randomized clinical trials (if no review)
 - **Excluded:** diagnostic, prognostic, or instrumentation studies, b) lower level of evidence, c) adult studies, e) generic preventive interventions e.g. good parenting, f) reviewed an entire discipline e.g. PT/OT/ST without specific intervention, g) 2nd publication of same study, h) unpublished or not peer-reviewed

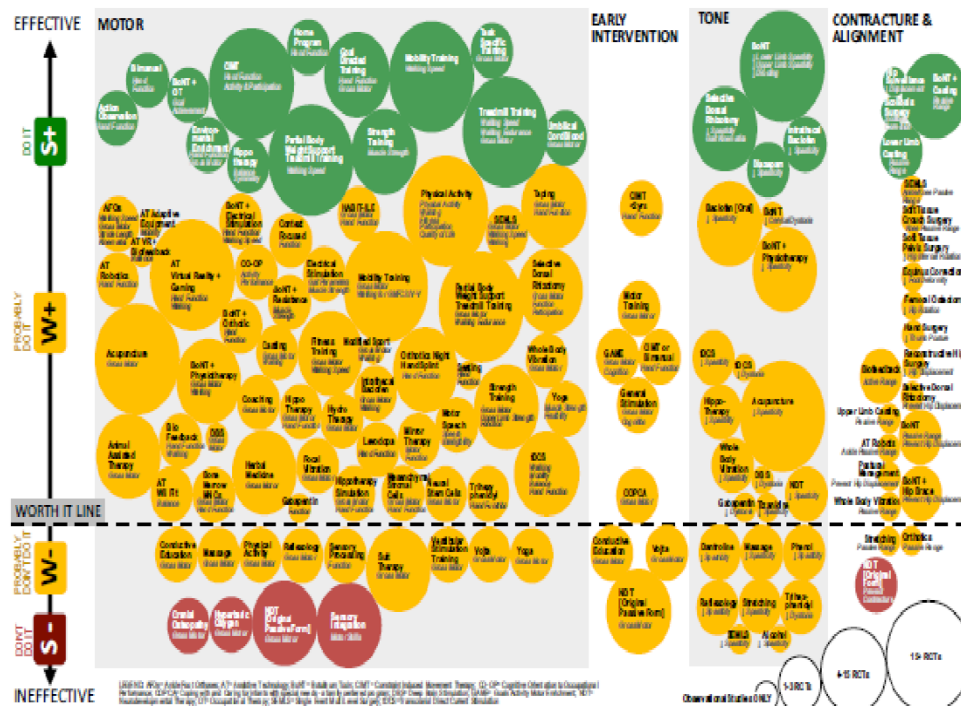


Introduction

- **Participants:**
 - *Prevention studies:*
 - Pregnant mothers or neonates
 - *Interventions studies:*
 - Children living with CP, >25% had a Dx of CP
 - Encompassed mixed populations
- **GRADE and Evidence Alert Traffic Light System:**
 - Two independent raters with unanimous agreement
 - **Grade:** rating system endorsed by WHO
 - *Quality of evidence* using a 4-point system (High-Moderate-Low-Very Low)
 - Example: RCT 4/4 (High) vs Observational study 2/4 (Low)
 - If no published evidence, then expert opinion was used
 - *Strength of the recommendation*
 - Weigh benefits, harms, resource usage, cost effectiveness, health equity, acceptability to customer, implementation feasibility,



Traffic Light System



Green light: "Go"

- High quality evidence from randomized clinical trials and systematic reviews indicates intervention effectiveness

Yellow Light: "Caution"

- Measure clinical outcomes
- Promising evidence suggests possible effectiveness, but *more research would increase confidence in estimate of effect*
- Conflicting findings exist; unclear how patient might respond

Red: "STOP"

- High quality evidence from RCT and systematic reviews indicated ineffectiveness or harm

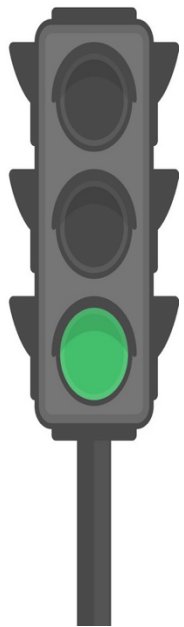


RESULTS

- Total number of included articles = 247
- Included studies involving participants affected by cerebral palsy (spastic, dyskinetic, or ataxic) of any topography and functional ability Gross Motor Function Classification System (GMFCS I-V) and Manual Ability Classification System (MACS I-V)
- Additional 118 interventions since 2013 review
- 23% of interventions- prevention of cerebral palsy
- 77% of interventions- management of cerebral palsy



ANTENATAL PREVENTION



Do It

- Antenatal Corticosteroids
- Magnesium Sulfate



Probably Do It

- Anti-hypertensives
- Betamimetics
- Progesterone

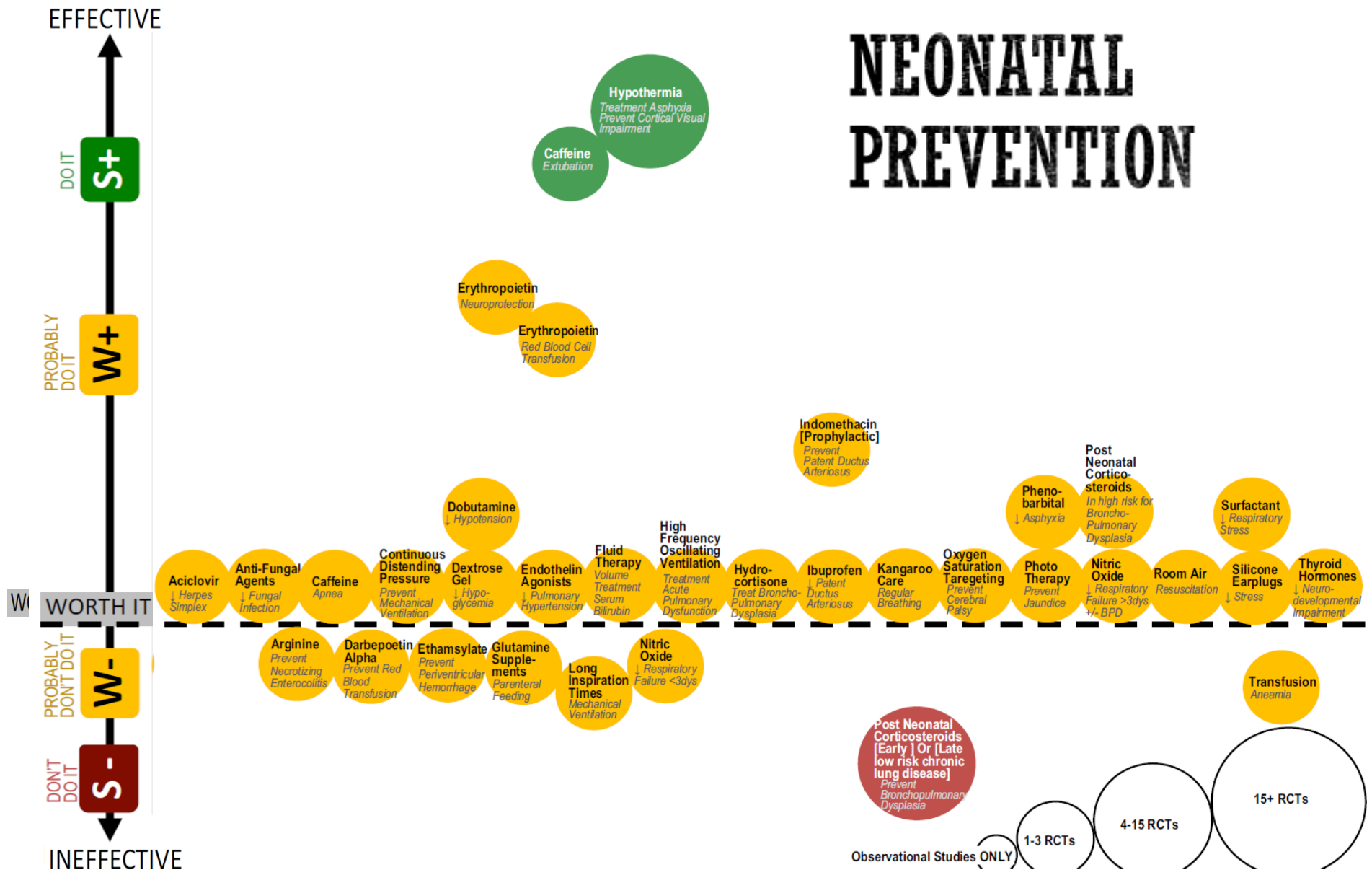


Probably Don't Do It

- Antibiotics
- Immediate delivery
- Continuous Cardiotocography
- Phenobarbital
- Vitamin K



NEONATAL PREVENTION



MOTOR INTERVENTIONS

Do It



- **Constraint induced movement therapy (CIMT)**
- **Mobility training**
- **Treadmill training**
- Action observation training
- Bimanual training
- Occupational therapy post botulinum toxin
- Functional chewing therapy
- Goal directed training
- Hippotherapy
- Strength training
- Umbilical cord blood



MOTOR INTERVENTIONS



Probably Do It

- **Acupuncture**
- **Animal-assisted therapy**
- **Virtual reality serious gaming**
- **Physical activity**
- Taping
- AT Robotics
- AFOs
- Electrical stimulation
- Casting
- Orthotic night hand splints
- Herbal medicine
- Hand Arm Bimanual Intensive Therapy Including Lower Extremities (HABIT-ILE)
- Mirror therapy
- Strength training
- Whole body vibration
- Yoga- for flexibility and strength
- Gabapentin
- Levodopa
- Trihexyphenidyl
- Stem cells

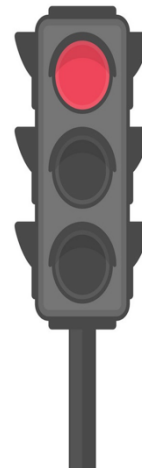


MOTOR INTERVENTIONS



Probably Don't Do It

- **Suit therapy- no additive effect to motor therapy**
- Massage
- Reflexology
- Vojta
- Yoga
- Conductive education
- Vestibular stimulation training
- Sensory processing



Don't Do It

- Neurodevelopmental Therapy (NDT)
 - Original passive form
- Sensory integration
- Cranial osteopathy
- Hyperbaric oxygen

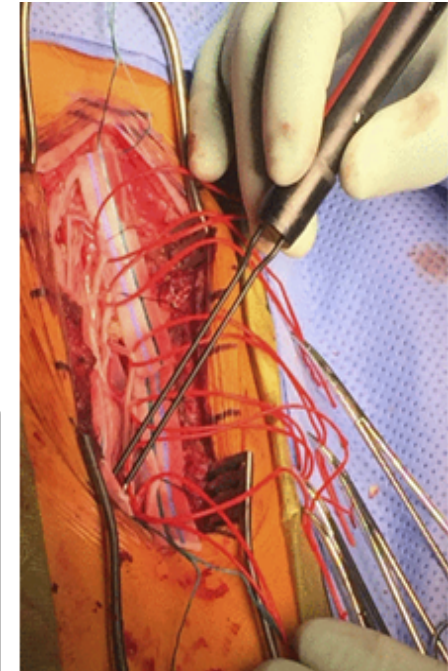
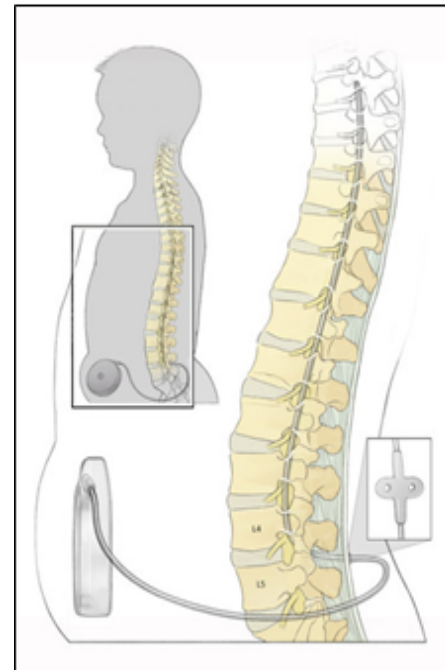


TONE



Do It

- **Botulinum toxin (BoNT)**
 - Limb spasticity
 - Drooling
- Selective dorsal rhizotomy
- Intrathecal baclofen
- Diazepam



TONE

Probably Do It

- **Acupuncture**
- Oral baclofen
- BoNT + physiotherapy
- BoNT for cervical dystonia
- Hippotherapy



- Whole body vibration
- Gabapentin- dystonia
- Tizanidine- spasticity
- NDT
- Transcranial Direct Current Stimulation (tDCS)
- Deep brain stimulation



ONE



Probably Don't Do It

- Stretching
- Reflexology
- Phenol
- Trihexphenidyl
 - Antimuscarinic therapy
- Single Event Multi-level Surgery (SEMLS)
- Alcohol



Study Contracture prevention and management Design

- **Contractures:**
 - The most common complication in CP
 - Prevention and management on a continuum
- **Early/"high-risk" for contractures:**
 - High intensity self-generated active movement
 - Active movement
 - Standing frame (GMSCF 4-5)
 - Botox
- **Contractures present:**
 - Serial casting
 - Skill dependent
 - Effects enhanced when applied 4 weeks after BoT
 - Change Q3 days rather than weekly
 - Strength training: (after casting)
 - Goal Directed Training



Contractures

- **Single event multi-level surgery**
 - Severe contractures >20 degrees
 - Casting no longer sufficient in isolation



- Passive stretching in isolation
- *Ankle robotics*
- *Biofeedback*
- *BoTox + electrical stimulation*
- *Whole body vibration*

- *Emergent low level quality evidence*
- *May help to manage contractures*
- *More research needed*



- **Neurodevelopmental Therapy**
 - **OT/PT (passive handling)**

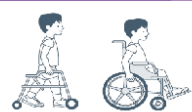
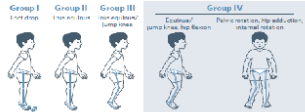


Hip surveillance

- **Hip dysplasia occurs in 30% of children with CP**
- **Prevention:**
 - Orthopedic surgery and physiotherapy
 - Botox
 - Intrathecal Baclofen
 - Selective dorsal Rhizotomy
 - Obturator nerve blocks
 - Positioning
 - Bracing
 - Weight bearing
 - Motor training
- **Early detection and management**
 - Early
 - Timely
 - Comprehensive



Australian Hip Surveillance Guidelines for Children with Cerebral Palsy 2020

GMFCS I*	- Initial clinical assessment at 24 months of age (or at identification if older than 24 months). No routine AP pelvic radiograph required. - Review at 3 years of age. - Verify GMFCS level. - If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required. - Review at 5 years of age. - Verify GMFCS level.	- If GMFCS level has changed, continue surveillance according to confirmed classification. - If identified as Winters, Gage and Hicks (WGH) group IV hemiplegia, continue surveillance according to WGI group IV classification. - Review at 5 years of age. - Verify GMFCS level.	- If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required and if no other significant signs, discharge from surveillance. - If GMFCS level has changed, or if identified as WGI group IV hemiplegia, continue surveillance according to confirmed classification.	
GMFCS II*	- Initial clinical assessment and AP pelvic radiograph at 24 months of age (or at identification if older than 24 months). - Review at 3 years of age. - Verify GMFCS level. - If GMFCS II confirmed, repeat clinical assessment. AP pelvic radiograph is NOT required. - If GMFCS level has changed, continue surveillance according to confirmed classification. - Review at 5 years of age. - Verify GMFCS level.	- If GMFCS level II confirmed, repeat clinical assessment and AP pelvic radiograph. - If GMFCS level has changed, or if identified as WGI group IV hemiplegia, continue surveillance according to confirmed classification. - If MP is abnormal continue 12 monthly surveillance until stability is established. - Review at 8 to 10 years of age. - Verify GMFCS level. - If GMFCS II confirmed, repeat clinical assessment and AP pelvic radiograph.	- If GMFCS level has changed, or if identified as WGH group IV hemiplegia, continue surveillance according to confirmed classification. - If MP is stable, discharge from surveillance. - If MP is abnormal continue 12 monthly surveillance, including AP pelvic radiograph, until stability is established or skeletal maturity. - In the presence of pelvic obliquity, leg length discrepancy or deteriorating gait, continue 12 monthly surveillance.	
GMFCS III*	- Initial clinical assessment and AP pelvic radiograph at 24 months of age. - Review at 3 years of age. - Verify GMFCS level. - If GMFCS III confirmed, repeat clinical assessment and AP pelvic radiograph.	- If GMFCS level has changed, continue surveillance according to confirmed classification. - Continue 12 monthly surveillance with clinical assessment and AP pelvic radiograph until skeletal maturity.	At skeletal maturity, in the presence of pelvic obliquity, leg length discrepancy or deteriorating gait, continue 12 monthly surveillance.	
GMFCS IV*	- Initial clinical assessment and AP pelvic radiograph at 12 to 24 months of age. - Review 6 months later. - Verify GMFCS level. - If GMFCS IV confirmed, repeat clinical assessment and AP pelvic radiograph. - If GMFCS level has changed, continue surveillance according to confirmed classification.	- Continue 6 monthly surveillance until MP stability is established. - If MP is abnormal continue 6 monthly surveillance until MP stability is established. - When MP is stable reduce frequency of surveillance to 12 monthly until skeletal maturity.	- Independent of MP, when clinical and/or radiographic evidence of scoliosis or pelvic obliquity is present, 6 monthly surveillance is required until skeletal maturity. - At skeletal maturity, if MP is abnormal and progressive scoliosis or significant pelvic obliquity is present, continue 12 monthly surveillance.	
GMFCS V*	- Initial clinical assessment and AP pelvic radiograph at 12 to 24 months of age. - Review 6 months later. - Verify GMFCS level. - If GMFCS V confirmed, repeat clinical assessment and AP pelvic radiograph. - If GMFCS level has changed, continue surveillance according to confirmed classification.	- Continue 6 monthly surveillance until MP stability is established. - If MP is abnormal continue 6 monthly surveillance until MP stability is established. - When MP is stable reduce frequency of surveillance to 12 monthly until skeletal maturity.	- Independent of MP, when clinical and/or radiographic evidence of scoliosis or pelvic obliquity is present, 6 monthly surveillance is required until skeletal maturity. - At skeletal maturity, if MP is abnormal and progressive scoliosis or significant pelvic obliquity is present, continue 12 monthly surveillance.	
Winters, Gage and Hicks hemiplegia group IV (WGI IV)*	- WGI group IV gait pattern usually develops by 4 to 5 years of age. - The child with a classification of WGH group IV has the potential for late onset progressive hip displacement regardless of GMFCS level. - Review at 5 years of age. - Verify WGH gait classification and GMFCS level. - If WGI group IV confirmed, repeat clinical assessment and AP pelvic radiograph.	- If not WGI group IV continue according to GMFCS classification. - If MP is stable, review at 10 years of age. - If MP is abnormal, continue 12 monthly surveillance including AP pelvic radiograph, until MP stability is established. - Review at 10 years of age. - Verify WGH classification. - If WGI group IV confirmed, repeat clinical assessment and AP pelvic radiograph.	- If not WGI group IV continue according to GMFCS classification. - Continue 12 monthly surveillance until skeletal maturity. - At skeletal maturity if significant scoliosis, pelvic obliquity, leg length discrepancy or deteriorating gait are present, continue 12 monthly surveillance.	 Gait patterns in hemiplegia (Winters, Gage and Hicks, 1987)



Hip surveillance

GMFCS I*

- Initial clinical assessment at 24 months of age (or at identification if older than 24 months).
No routine AP pelvic radiograph required
- Review at 3 years of age
 - Verify GMFCS level
 - If GMFCS I is confirmed, repeat clinical assessment. AP pelvic radiograph is **NOT** required

GMFCS II*

- Initial clinical assessment and AP pelvic radiograph at 24 months of age (or at identification if older than 24 months)
- Review at 3 years of age
 - Verify GMFCS level
 - If GMFCS II confirmed, repeat clinical assessment. AP pelvic radiograph is **NOT** required
 - If GMFCS level has changed, continue surveillance according to confirmed classification
- Review at 5 years of age
 - Verify GMFCS level

GMFCS III*

- Initial clinical assessment and AP pelvic radiograph at 24 months of age
- Review at 3 years of age
 - Verify GMFCS level
 - If GMFCS III confirmed, repeat clinical assessment and AP pelvic radiograph

GMFCS IV*

- Initial clinical assessment and AP pelvic radiograph at 12 to 24 months of age
- Review 6 months later
 - Verify GMFCS level
 - If GMFCS IV confirmed, repeat clinical assessment and AP pelvic radiograph
 - If GMFCS level has changed, continue surveillance according to confirmed classification

GMFCS V*

- Initial clinical assessment and AP pelvic radiograph at 12 to 24 months of age
- Review 6 months later
 - Verify GMFCS level
 - If GMFCS IV confirmed, repeat clinical assessment and AP pelvic radiograph
 - If GMFCS level has changed, continue surveillance according to confirmed classification

Winters, Gage and Hicks hemiplegia group IV (WGH IV)*

WGH group IV gait pattern usually declares itself by 4 to 5 years of age.

The child with a classification of WGH group IV has the potential for late onset progressive hip displacement regardless of GMFCS level.

- Review at 5 years of age
 - Verify WGH gait classification and GMFCS level
 - If WGH group IV confirmed, repeat clinical assessment and AP pelvic radiograph



Physical activity/ participation

- **Moderate-vigorous physical activity:**

- Should replace sedentary behavior with light physical activity
 - Improves fitness, activity, ambulation & motility, and NOT gross motor skills
- Activity training
- Strength training
- Behavioral change strategies



- **Participation:**

- Participation-based PT/OT therapy for children with physical disabilities
 - Patient-family partnership with therapist
 - Collaboration
 - Goal-oriented
 - Family-centered
 - Strengths-based
 - Ecological/natural environment
 - Self-determined
- Real-life experiences to learn new activities and develop skills to optimize participation and social engagement



Dysphagia management

- **Dysphagia:**

- Occurs in up to 50% of children with CP (especially during infancy)
- 1 Out of 15 require gastrostomy tube
- Aspiration and respiratory illness associated with increased mortality

Strategies:

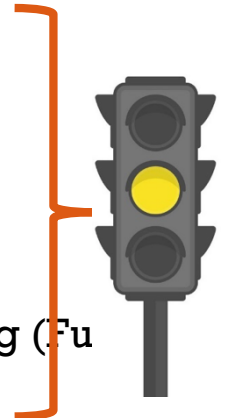
- **Electrical stimulation and oral sensorimotor therapy**

- Better lip closure with swallowing



- **Prevention strategies:**

- Airway clearance techniques
- Oral sensorimotor therapy
- Thickened liquids
- Sialorrhea management
- Upper airway interventions (e.g. bronchodilators, CPT)
- Antibiotics
- GI interventions (e.g. reflux medications)
- Spinal surgery
- Motor learning-based oral sensory intervention (Functional Chewing Training (Fu
 - Improves chewing, reduces tongue thrust and sialorrhea



EARLY INTERVENTIONS

- Possible to diagnose CP as early as three months of age (corrected) which leads to earlier intervention
- Before, only 61-64% of infants with CP were being referred to EI due to late diagnosis
 - It affected the volume and methodological quality of EI clinical trials conducted and published for infants with CP
- More trials for EI targeting other developmental domains such as cognition, feeding, and communication will emerge in the near future

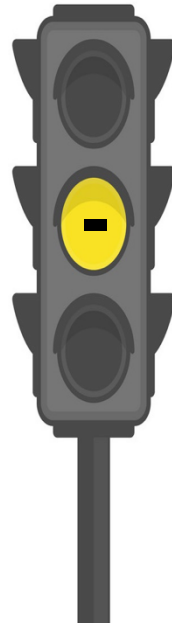


EARLY INTERVENTION CONTINUED...



Probably Do It

- Child-active motor learning early interventions
- Baby-Constraint Induced Movement Therapy (CIMT)
- CIMT or Bimanual
- Coping With and Caring for Infants With Special Needs (COPCA)
- GAME
- General Stimulation
- Small Steps



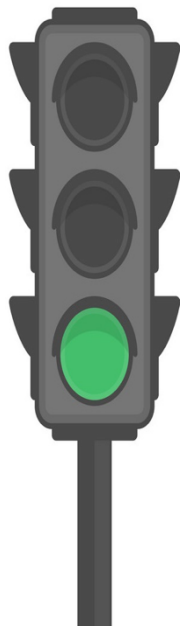
Probably Don't Do It

- Conductive Education
- Vojta
- Neurodevelopmental Therapy (Passive Approach)



COGNITIVE INTERVENTIONS

- 46% of children with CP have co-occurring intellectual disability however, the comorbidity is declining
- Co-occurring disability with severe physical disability increases the risk for premature death during childhood



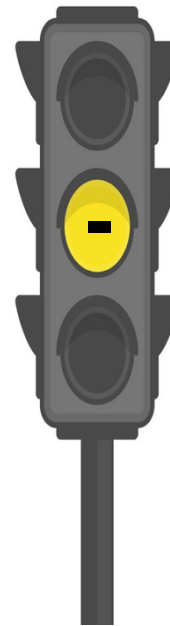
Do It

- Literacy



Probably Do It

- AT Robotics
- Cognitive Orientation to Occupational Performance (CO-OP)
- General Early Stimulation
- Goals-Activity Motor Enrichment (GAME)
- Play Therapy
- Neural Stem Cells
- Umbilical Cord Blood



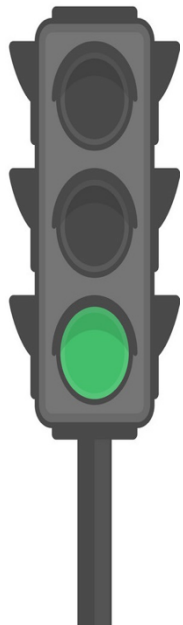
Probably Don't Do It

- Yoga



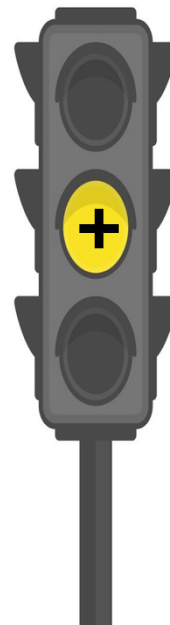
PARENT INTERVENTIONS

- Parents also needs the support!
 - Parent intervention is essential to optimize the child's development and to protect a parent's mental health
- The early and intentional support of parents offers important possibilities for improving children's outcomes



Do It

- Stepping Stones Triple P
- Acceptance and Commitment Therapy (ACT)



Probably Do It

- AT Adaptive Equipment
- Coaching
- Conductive Therapy
- Dysphagia Management
- Parent Education
- Parent Education
- Solution Focused Therapy
- Respite



Summary

Guide to interpretation:

- Interventions evaluated based on available published evidence NOT personal opinion
- Group response does not address individual variation in response
- CP is a heterogeneous condition:
 - RCT results based on experimental treatment compared to control
 - Individual responses among children with CP may be better or worse than average trial data
 - Most of the RCT's have wide confidence intervals reflects population heterogeneity and variation in responses



Summary

How to utilize guidelines:

- Define intervention goals with child and family
- Match goals to outcome indicator
 - Evaluate options and best evidence
- Select intervention with highest level of evidence, and counsel family regarding average response (may vary for their child)
 - Monitor effects and goals attained
- Interventions that are ineffective, unavailable, family declines service, then select 2nd most effective intervention
- Overall, develop plan that best matches child's capabilities and optimize inclusion



Summary

Study limitations:

- **Systematic review of systematic reviews**
 - No new knowledge created
- **Cochrane review process favors inclusion of RCT's**
 - Important operational studies excluded or under emphasized
- **Review lacks key details**
 - Intervention fidelity, key ingredients, best responders or non-responders
- **Systematic reviews not without bias**
 - *Publication bias* despite being highest level of evidence
- **Systematic reviews can be of variable methodological quality**
 - Statistical errors
 - Misinterpretation of meta-analysis e.g. SD crossed line of no effect, but authors used standard mean difference alone and erroneously interpreted intervention as effective.
 - Not all relevant systematic reviews included in the original analysis or important analysis despite thorough search strategy.
 - The estimate of effect may have changed
 - Articles not published in English not published; may have overlooked important data



Conclusions

- Summary of best available evidence in 2019 for CP intervention
- Highlights areas needing more research
- A significant number of cross discipline Green light intervention strategies were identified for prevention, allied health interventions, medical, surgical, pharmacological, regenerative therapy
- More research is needed for a number of promising therapies that would advance decision-making by families and clinicians





QUESTIONS?

