

Implementation of Evidence-Based Physical and Occupational Therapy for Children with or at Risk for Cerebral Palsy

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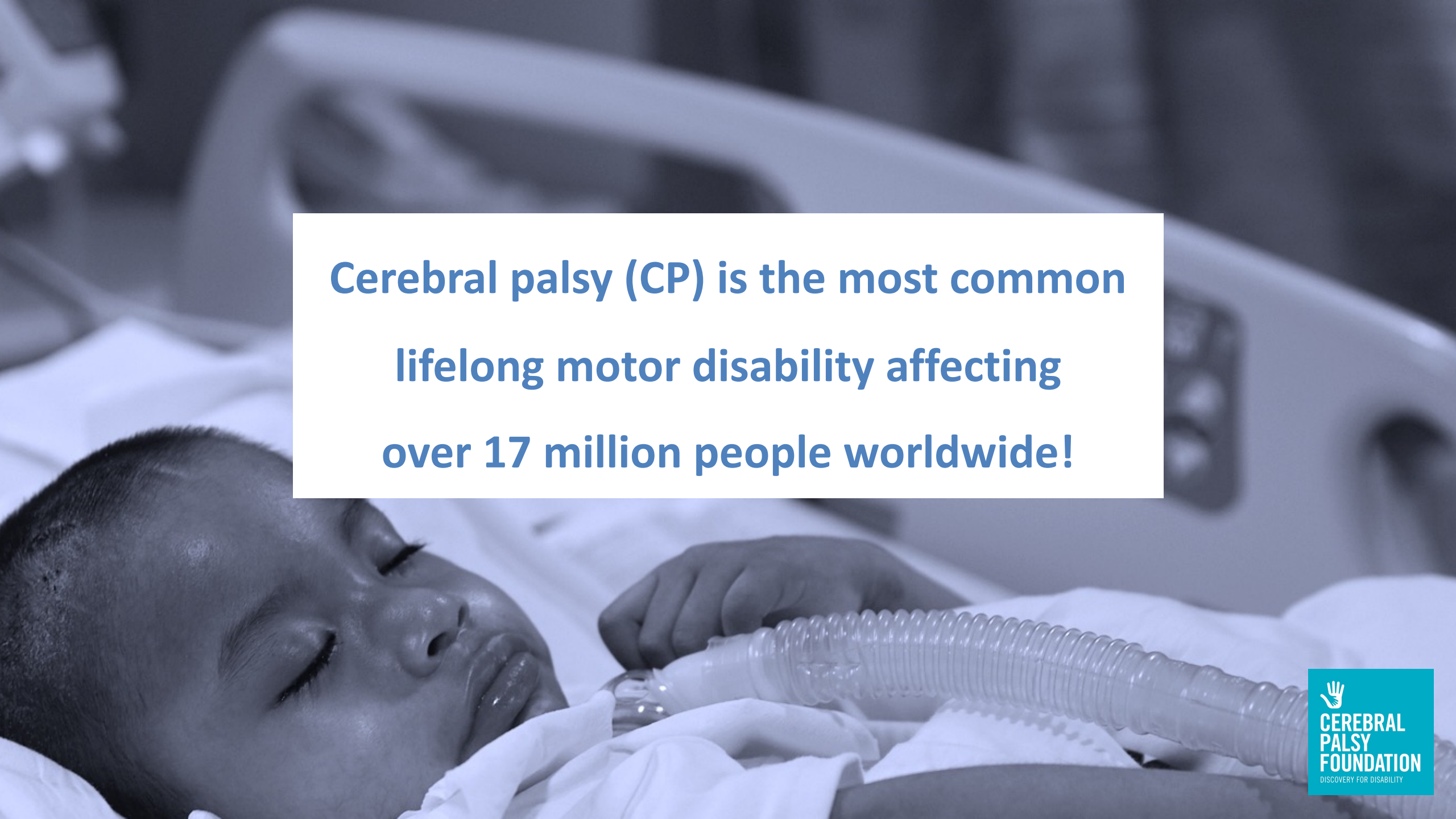
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A newborn baby is lying in a hospital bed, appearing to be asleep. The baby is wearing a clear, corrugated breathing tube that is connected to their mouth. The background is slightly blurred, showing the white frame of the hospital bed and some medical equipment. The overall tone of the image is soft and clinical.

**Cerebral palsy (CP) is the most common
lifelong motor disability affecting
over 17 million people worldwide!**

*CP is an injury to the developing
brain that interferes with
movement and coordination*

Overview

- Early detection of cerebral palsy (CP)
 - Leads to better parent and child outcomes
 - Allows for early intervention
 - Has been implemented internationally, nationally and at UCLA
- Early physical therapy (PT) and occupational therapy (OT)
 - Age 0 – 3 years of age is when brain plasticity is optimal
 - Should be based on best evidence **not** best social media
- Children have a right to access PT and OT services (Part C IDEA)
- System changes are needed for early access to services

Early Diagnosis is Important to Parents

- Clinicians often delay a “negative” diagnosis.
- A delay can decrease parents’ satisfaction and affect their mental health.
- The time between signs that their infant has a problem and receiving a diagnosis is stressful and should be minimized.
- Parents want an honest, hopeful, direct message.
- Parents see benefits to obtaining a diagnosis.
- Parents are very accepting of a “high-risk for CP” classification.

(Baird 2000, Guttman 2018, Byrne 2019)

Early intervention is important for infants

- Infants with cerebral palsy move less & with less complexity
- Leads to elimination or alteration of brain pathways and muscle weakness (move even less).
- Brain & muscles have most potential for plasticity early
- Mobility is critical for the development of infants!
- Gross motor ability is linked to cognitive & social development

Movement is less frequent and less complex in CP



Selective motor control
Age = 12 months



Coupled movement
Age = 11 months

Movement is less complex in CP

Kicking - child with left hemiplegia



Right leg = selective motor control



Left leg = coupled movement

Corticospinal tracts

responsible for selective motor control

Commonly injured in **spastic CP**

White matter damage of prematurity

- Periventricular leukomalacia on brain MRI

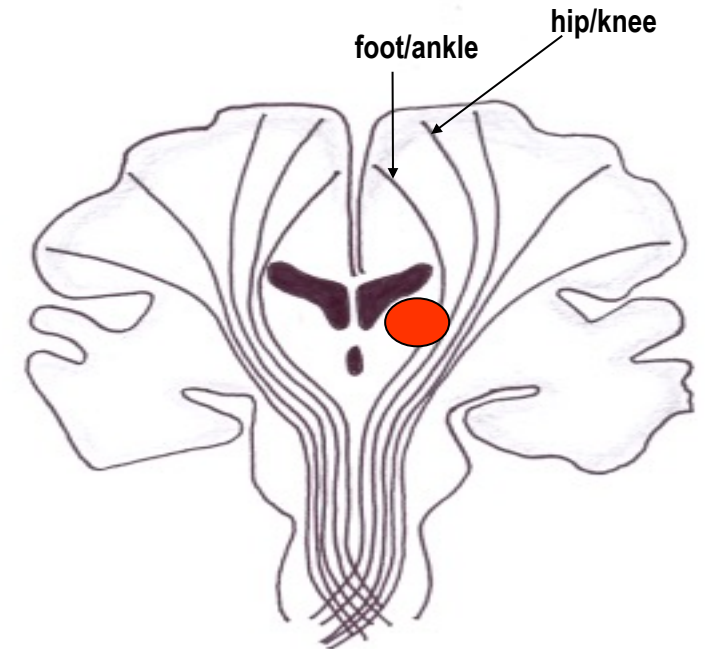
CSTs: responsible for skilled voluntary movement

- Selectivity
- Force
- Speed
- Timing
- Pattern

Distal structures more vulnerable to injury (foot / ankle)

Mirroring

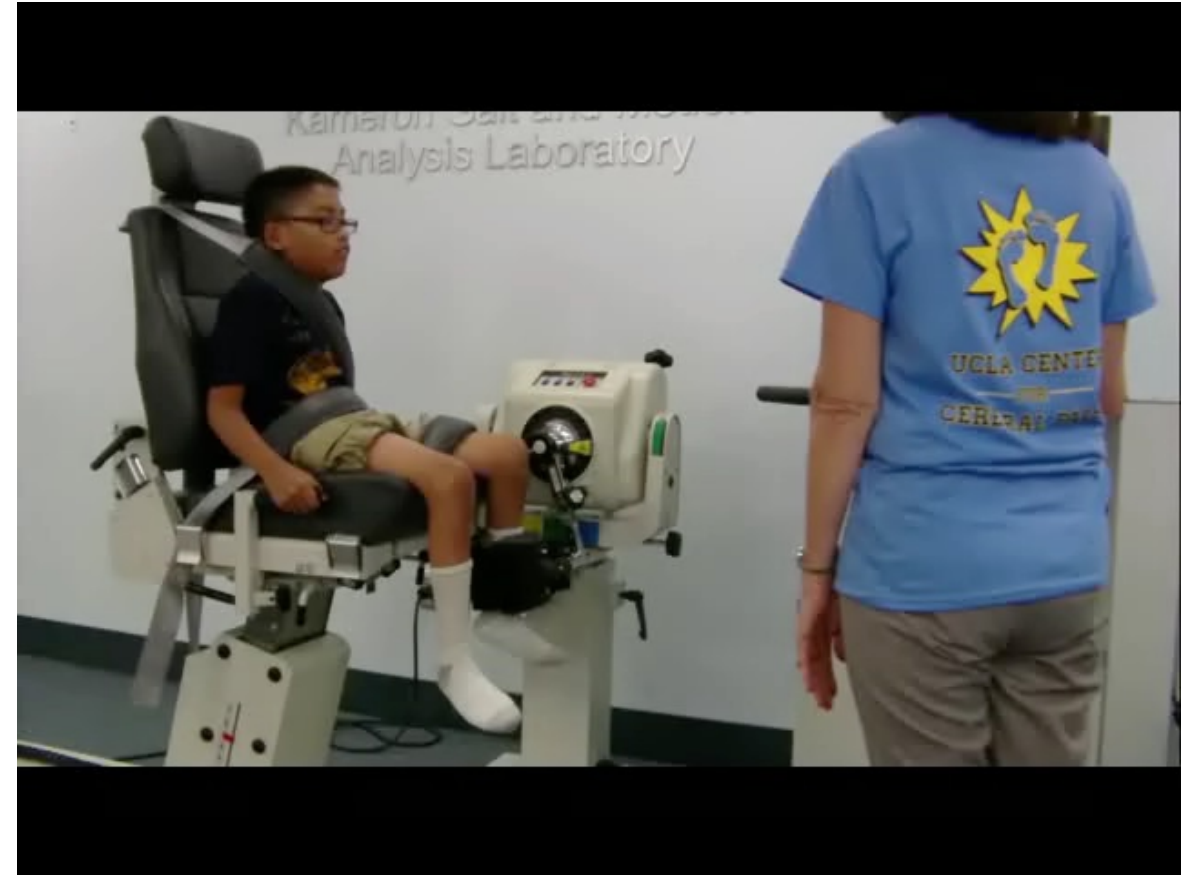
- ipsilateral CST preservation
- maladaptive plasticity



Coronal section

Alteration of brain pathways occurs early

obligatory mirroring



Early diagnosis is possible

- Many babies at risk for CP enter the medical system at birth
 - Premature or have hypoxic ischemic encephalopathy
 - Spend time in the Neonatal Intensive Care Unit and have had brain imaging studies
 - Scheduled for High-Risk Infant Follow-up Clinics
- International guidelines published for early detection (JAMA, 2017)
- Cerebral Palsy Foundation funded an early detection network
 - 5 Medical Centers to implement early detection including UCLA
 - System change needed = **“Implementation Science”**

Implementation framework



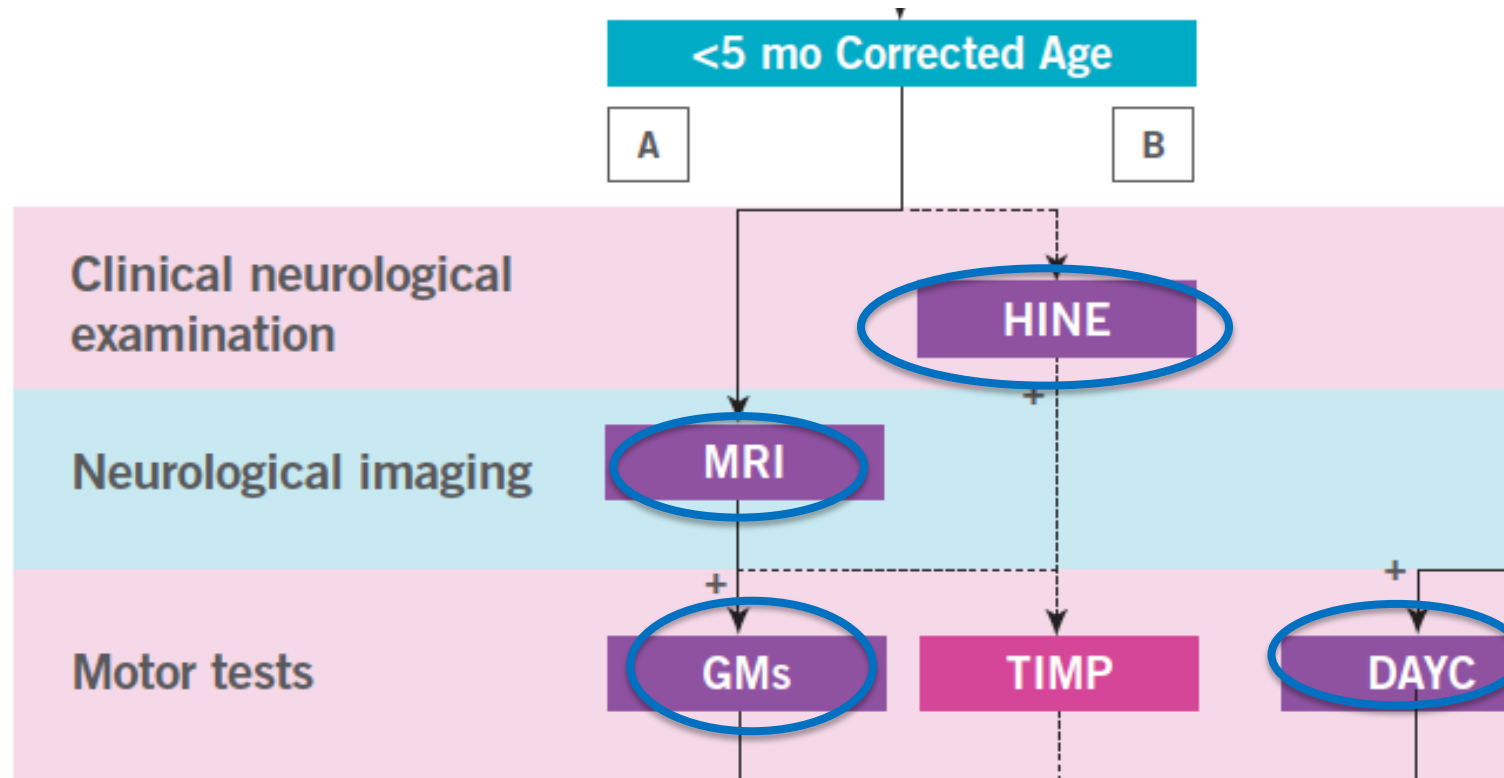
From Westgard 2020 - The Use of Implementation Science Tools to Design, Implement, and Monitor a Community-Based mHealth Intervention for Child Health in the Amazon.

Early Detection Network Design – Initial Steps

1. Perform systematic review of the evidence to identify pathways and tools for detection
2. Recruit clinician teams in **High-Risk Infant Follow-up (HRIF)** Clinics
3. Involve parent and community stakeholders

Systematic review of the evidence

Chose 4 Evaluations for Detection in High Risk Follow-up (HRIFU) Clinics



1. HINE = Hammersmitjh Infant Neurological Exam
2. MRI = Brain imaging

3. GM = Generalized Movement Assessment
4. DAYC = Developmental Assessment for Young Children

Is Implementation possible?

Performed SWOT Analyses

- Strategic planning technique
- Works best when diverse groups or voices within an organization are free to provide realistic data points
- For example, most HRIFU clinics weren't seeing children between 3-5 months age requirement for the Generalized Movement Assessment.

Strengths

Strengths are based on internal factors and viewed as helpful to your organization. What are your competitive advantages?

Weaknesses

Weaknesses are based on internal factors and viewed as harmful to the organization. What aspects of the business are holding you back?

Opportunities

Opportunities are based on external factors and viewed as helpful to your organization. What macro trends are creating opportunity for you?

Threats

Threats are based on external factors and viewed as harmful to your organization. How can your weaknesses create a threat to your objective?

Essential Program Components

- Move HRIFU clinic timing to 3-5 months corrected age
- Standardized training for all evaluations
- Funding dedicated personnel – typically a clinic coordinator
- Cerebral Palsy Foundation provided administration, expertise, information, guidance and strategies

Early Intervention for PT & OT CPF Grant

- CPF grant to implement early intervention for CP
 - Eileen Fowler PT, PhD, UCLA Center for CP
 - Loretta Staudt MS PT, UCLA Intervention Program & Center for CP
 - Barbara Sargent, Associate Professor, Biokinesiology and Physical therapy, USC
- Partnering with California Children's Services, Los Angeles County who provide PT and OT services

Early Detection Network - Success

- National average age of CP diagnosis = approximately 2 years at study onset.
- 5 institutions: UCLA, Kennedy-Kreiger, U. Texas-Houston, Nationwide Children's, U. Utah
- Age of diagnosis decreased from **19.5 to 9.5 months** over a one-year period.

CCS SWOT

Helpful

Harmful

Strengths

Weaknesses

Internal

- Serve a large population of children with CP
- Well-organized outpatient clinics with PTs & OTs
- Dedicated Education Team
- Provide DME and orthotics
- Collaborations: Regional Centers and Schools

- Small population of children 0-3 years
- Out-patient services/Regional Center in-home
- No standardized protocols for infants & toddlers
- No speech therapy

External

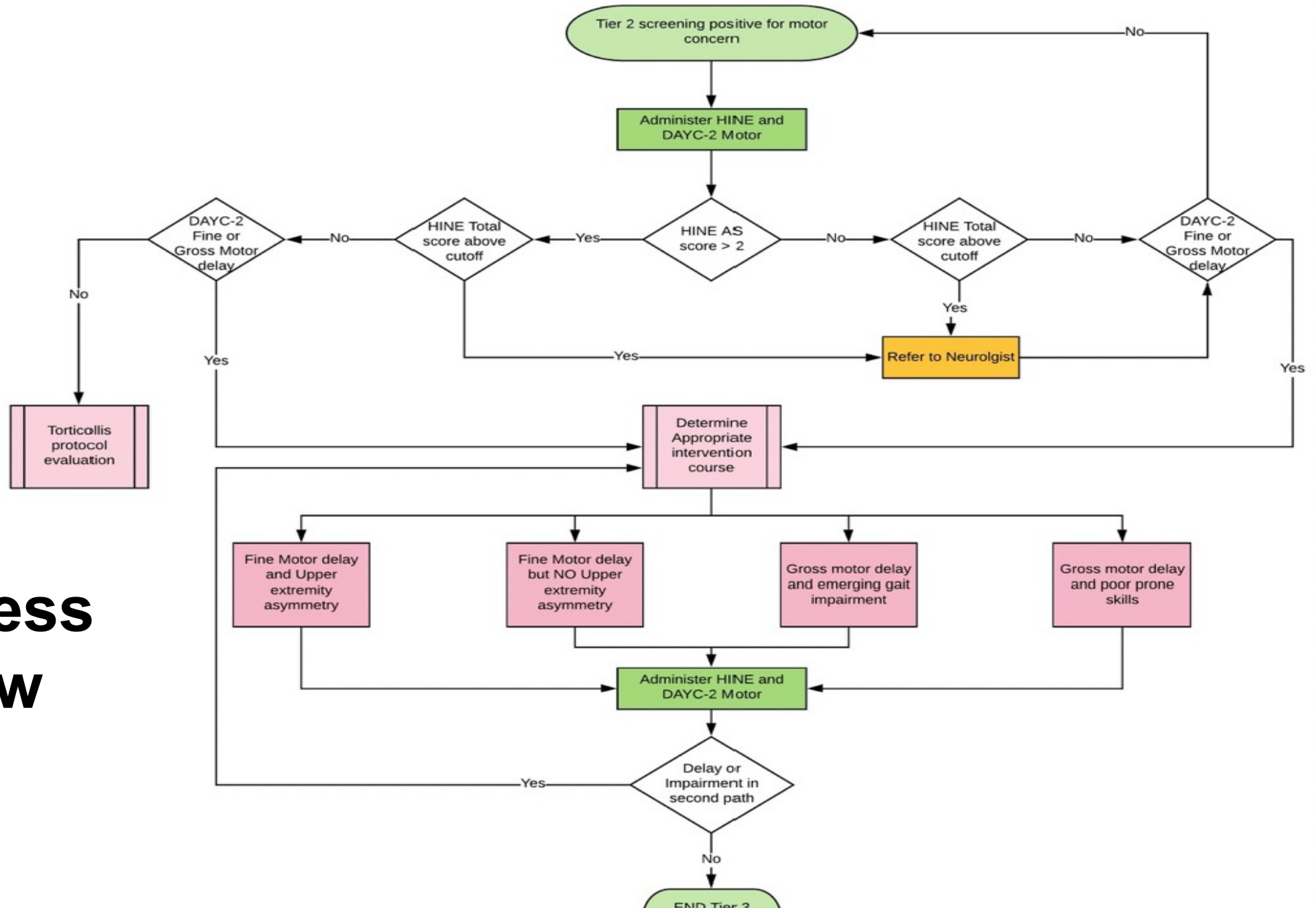
Opportunities

Threats

- CPF funding available: training & implementation
- CPF ED & Intervention Network - UCLA
- Working group to increase CCS referrals - USC
- Need for standardized protocols for 0-3 years

- Currently, most infants referred to Regional Center
- Families may prefer in-home services
- Need for agency, HRIF clinic, parent education
- Lack of staff to dedicate solely to this project

Process Flow



Systematic review of the evidence supports

Intervention	Outcome (ICF)
Environmental enrichment	Environmental Factors/Activity
Child initiated and directed activities	Activity
Task specific/ goal directed	Activity
Intensive practice	Activity
Parent-infant transaction approaches	Environmental Factors/ Activity

Morgan et al. (2013); Case-Smith et al. (2013); Morgan et al. (2016); Hadders-Algra (2016) Chorna et al. (2016)

Principles of Neuroplasticity

The 5 “E” Words

1. **EARLY** (as young as possible)
2. **ENGAGEMENT** is essential to learning
3. Self-**EXPLORATION**
4. **ENRICHED ENVIRONMENT**
5. Parents/caregivers integrate activities into **EVERYDAY** routines

Existing and new intervention protocols

1. Train therapists in the protocols
2. Training for outcome measures
3. Specify standard frequency, dosage and duration of treatment prior to re-assessment

Reasons for Lack of Effectiveness – chart review

1. Not doing the right intervention (TYPE)
2. Not doing it intensively enough (DOSE)
3. Not doing it at the right time (TIMING)

Upper Limb Intervention Example: Hemiplegic CP

APPLES

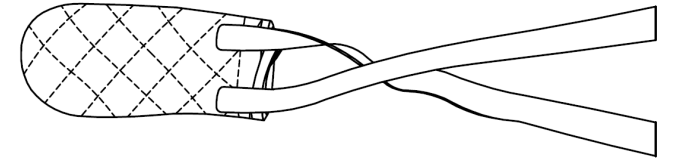
- 4 week intervention: therapist instruction once weekly with parent administration in home
- Soft constraint (C-mitt) worn 6 hours/day, at least 5 days/week
- Daily sensorimotor activities
 - Unimanual reach and grasp
 - Unimanual targeted reach with “sticky” mitten
 - Bimanual coordination (without constraint)

Overview

- Family-focused
 - Principles of positive parenting
 - Build and reinforce parents' skills
- Principles of infant motor learning
 - Goal-directed
 - Infant-initiated

APPLES Components

- C-mitt Soft constraint allows sensation and weight bearing function



- Sensory bins
 - Lima/fava beans
 - Sand



- Sticky mitten + Velcro
- Toys and Bilateral activities



What does the evidence say?

- 72 Infants with CP (6–24 months old): randomized to treatment versus waitlisted group
- Median weekly constraint wear was 38 hours
- Parent-treatment fidelity averaged > 92%.
- Significant differences between the 2 groups in favor of treatment:
 - Greater reach smoothness (3D-kinematics),
 - Greater unimanual fine motor function (Bayley unimanual fine motor raw scores)
 - EEG measures of cortical somatosensory processing.

Lower Limb Intervention Example: Diplegic CP

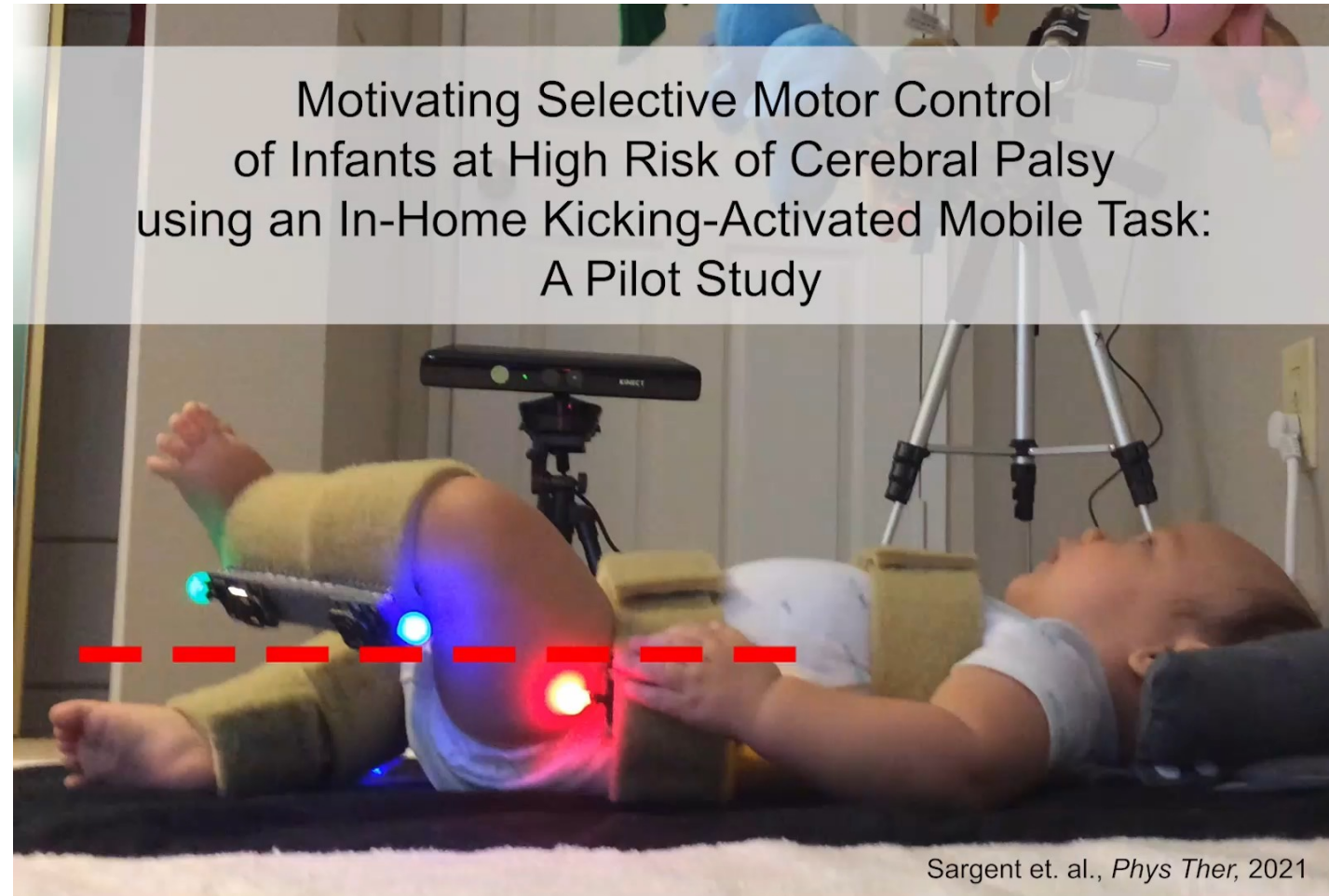
Selective Movement of Lower Extremity in Infants and Toddlers (Kicking)

- Cerebral palsy specific physical therapy for the lower limbs
- Development of skilled (complex) movement = selective motor control
- Focused on babies who are not yet rolling
- Practicing moving the hip knee and ankle independently from one another

Evidence:

1. Campbell et al: *J Pediatr Rehabil Med* 2012; *Pediatric PhysTher* 2015
2. Yang et al: *Semin Pediatr Neurol* 2013
3. Heathcock and Galloway: *Phys Ther* 2009
4. Sargent et al *Phys Ther* 2020, 2022 and
5. Kim et al *Infancy* 2021, 2021b

When playing with an infant kicking-activated mobile, infants at high risk of spastic cerebral palsy demonstrated more selective control when they learned the task



10 infants played with mobile for 8-10 min/day, 5 days/wk for 6 wks
Task-specific therapy

Home Environment

Play activities that promote skilled movement at home

- Suspended toys
- Baby gym
- Balloon, rattles, lights
- Hand to foot activities
- Ankle rattles, socks, tissue or cloth in toes



child with visual impairment

Other Play Activities

Kicking a ball while supported in gait trainer or harness

