EARLY INTERVENTION
for infants with or at risk of cerebral palsy

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Welcome from sunny Perth, Western Australia. While Australia differs in many ways from Denmark, as paediatric physiotherapists, we share the same aim of maximising the potential of the children and families with whom we work. Research in the areas of typical infant development and early intervention for infants with or at risk of motor delay has burgeoned in recent years. This brief article will provide you with some of the current evidence to help with your assessment, clinical reasoning and intervention options.

Physiotherapy assessment and clinical reasoning

The seminal article by Novak states the criteria and provides the evidence to make a diagnosis of CP[1]. The role of the paediatric physiotherapist is essential in this process. For those therapists who are not trained in the General Movements Assessment, other assessments can assist in the diagnosis. Whether the diagnosis is confirmed or equivocal, intervention for the infant with or at risk of CP must begin early.

Case study: *The infant with cerebral palsy (CP)*

Russell was born at 30+2/40, weighing 980gm. He is now 4 months corrected age and has a grade 3, right intraventricular haemorrhage. He lives with his parents. His mother is completing an online accounting course and is with Russell during the day. She works three nights a week as a waitress at a café. His father is an electrician and works five days a week in a store repairing electrical goods. Russell has been offered early intervention services.

- What framework would you use to inform your physiotherapy assessment, clinical reasoning and intervention?
- What assessments and outcome measures would be appropriate for this infant?
- What evidence will you discuss with his parents for motor intervention?

Collaborative decision-making with carers and the health care team to set goals for infants and their families can be structured using the F-words of childhood disability[2]. The F-words can also guide assessment and choice of outcome measures for all domains.

Physiotherapy intervention

A systematic review by Morgan investigating motor interventions in infants with CP recommends that the infant should be an active learner in an enriched and modified environment[3]. The authors stress that movement should be child-initiated and specific to the task being trained. The evidence shows that typical infants learn motor skills by practicing the skill. Infants learn to sit by practicing sitting and learn to stand by practicing standing. Variations in the amount of postural support provided by parents, the support surfaces that offer biomechanical challenges, and cognitive and social drivers all affect task practice and learning in context. Parents can be educated to apply these motor learning principles with their infant at risk of motor delay.

Hadders-Algra in their systematic review on early intervention for infants with high risk of CP advocate a multifaceted approach[4]. They add to the Morgan recommendations by including trial and error learning and developmental stimulation that address cognitive and social skills as well as motor skills[3].

Adult motor learning principles that can be applied to infants are:

• Goal setting
• Active learning
• Tasks that are practiced in context
• Intensity of practice
• Variability of practice
• Repetition – practice dosage

Motor practice

One key factor that was identified in both reviews was the dosage of practice required for the infant to learn skills. How much practice do infants need? When typical infants are learning
to walk, age (growth of body segments) and walking duration contribute to learning, but the most important factor is practice. Adolph conducted a longitudinal observational study with 9 to 17-month-old typical infants and measured a range of factors[5]. They report that infants spent up to 6hrs/day practicing walking, taking between 500 and 1500 steps/hr or 9000 steps/day. They practiced on variable support surfaces (with differences in friction, rigidity and texture), in different rooms in the home and outdoors and their practice varied within and between days. Essentially, they used variable and random practice to refine the skill of walking.

Like older children and adults, practice is essential for infants to learn motor skills. The practice in which typical infants engage to learn motor skills is not structured, but

may be infant-initiated, occurring during everyday routines, and is consistent with motor learning theory. Practice occurs when infants play independently and during infant-parent interactions during care and play.

In my PhD I measured infant activity (n = 100) using the Daily Activities of Infants Scale (DAIS) (https://www.can-child.ca/en/resources/50-additional-measures) which is a maternal-report diary. In a 24-hour snap-shot, I found that infants spent on average 4hrs in care activities (feeding, bathing, dressing and being carried), 4.6hrs playing (quiet and active), 1.4hrs in outings (shopping, visiting) and 14hrs sleeping. In total, infants have up to 8.6hrs/day to practice motor skills during care and play (fig 1). I also mapped infant activity over the course of the day (fig 2.) finding that the majority of infants are awake by 5:00 and asleep by 21:00; and during their wake time play and care activities overlap.

So, it seems apparent that typical infants have ample opportunities to be active and practice all types of learning (motor, cognitive, language, social) to support their development. My study found that active babies (measured using accelerometry) had better gross motor skills than less active babies as measured with the Peabody Developmental Motor Scales, version 2.

Changes are likely also occurring in body systems, such as the cardiopulmonary, neurological, muscular and skeletal, but these were not measured.

Temperament

How often do we hear parents say:

• »My baby is so busy – he wears me out!«
• »My baby likes to watch everything. She is so quiet and good.«
• »I can't take my baby anywhere. He cries all the time when we are not at home. I'm so tired looking after him.«
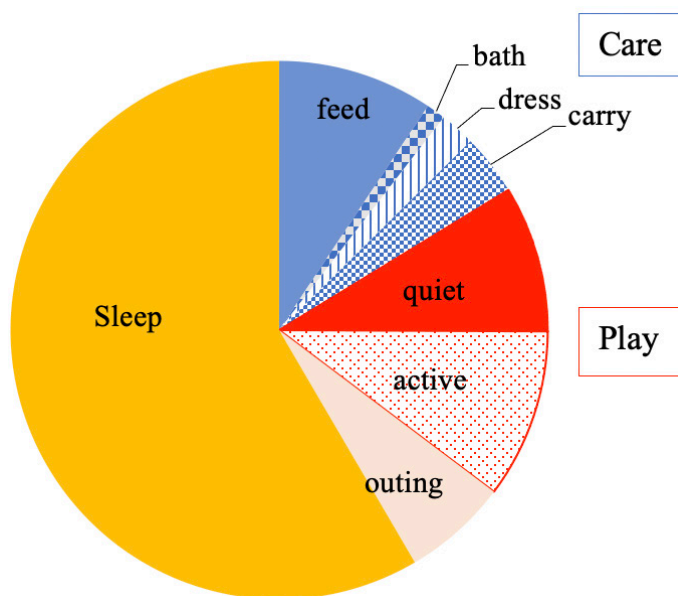

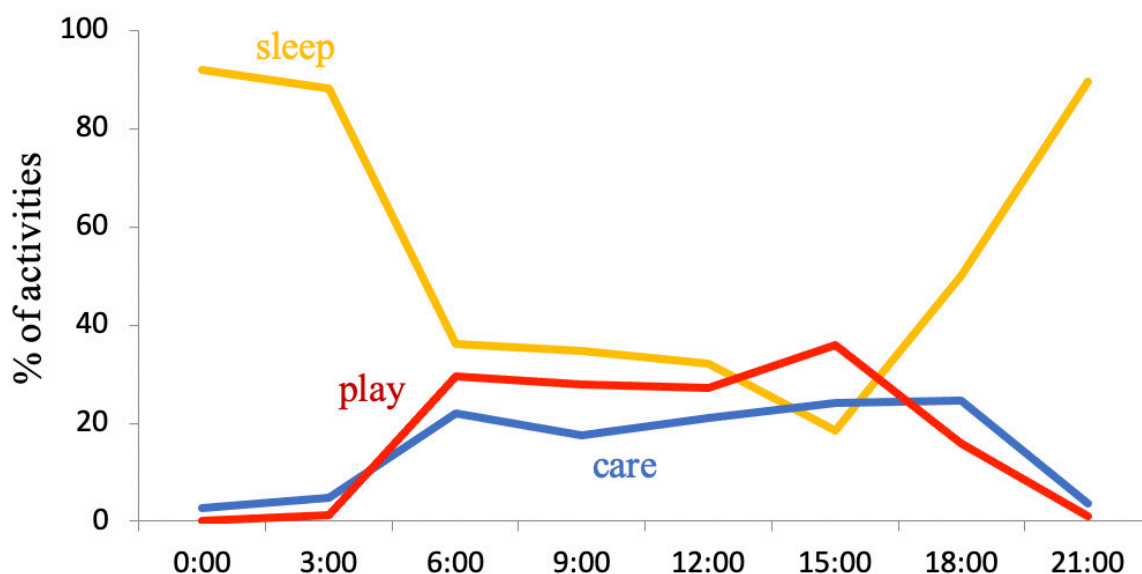*Fig 1. Duration of activities for infants aged 3 – 12 months.*

Fig 2. Relationship between activities over 24 hours.

These comments and the emotional responses of the parent affect the relationship between infants and their parents. Some infants appear to be inherently motivated to move and to be active participants in their exploration of the world, while others appear to be more passive or apprehensive. Inherent behavioural and emotional traits describe an infant's temperament. With relation to motor development, the amount of spontaneous activity in which an infant engages may be supported and extended by their parents. This bi-directional interaction between infant and parent could be interpreted as a form of motor practice. My PhD research found that infants who had high surgency/extraversion (outgoing temperament) as reported by their parents using the Infant Behavior Questionnaire-Revised (IBQ-R) were more active measured using accelerometry.

But, is the intensity of practice in which typical infants engage realistic for infants with or at risk of delay and their family? The influence of temperament of infants with CP on practice is not reported in the literature but is worth exploring.

State of the evidence for early intervention for children with CP

In a 2020 systematic review, Novak use a traffic light system to rate interventions: **Green** – »Go/Do it«; **Yellow** – »Probably do/don't«; **Red** – »Stop/don't do it«[6].

The authors offer the following summary from the **Green light** interventions:

- Set goals – collaborative goal setting is essential for both short and long-term goals
- Interventions could be used in combination targeting different aspects of the F-words
  - Fitness – spasticity management, ↑strength, aerobic capacity
  - Function – teach gait, teach fundamental motor skills, ↑PA
  - Friends – enhance community access, playgroup, social skills
  - Fun – opportunities for play, physical access
  - Family – respect each family's function, rules, rituals
  - Future – plan for independence, education, work
- Outcome measures – choose outcome measures with

sound psychometrics and those that are responsive to the intervention. Consider Quality of Life questionnaires for parents. Choose measures that are appropriate for multi-disciplinary teams as well as discipline specific measures.

• Family choice – along with family goals, families should be given a choice as to what intervention will be practical to implement in a family home. Discuss with parents what time they can commit to providing therapy taking into consideration other family commitments, e.g. parent working hours, siblings, extended family needs.

Some specific interventions that received the **Green light** included[6]:

• Parent coaching to enhance reciprocal interactions between parent and child, to enhance infant-initiated behaviours and infant trial-and-error learning to increase the infant's motor repertoire
• Parent coaching to increase family empowerment and quality of life

• Infant bimanual versus constraint-induced manual therapy (CIMT) – infants with a mean age of 12mths, practiced for 60 minutes/day (in short sessions) for 8 weeks. Both interventions were equally effective
• CIMT versus hand massage – CIMT high intensity practice = 30 minutes/day, 6 days/week for 12 weeks for a total of 36hrs of practice. Infants were assessed at 12mths of age showing that CIMT was more beneficial. Why might massage not be as beneficial?
• »Small Step program« which included training in mobility and hand function for 24 weeks with 6 home visits + communication for 6 weeks with 4 home visits was equally effective as standard care (monthly hospital visit for total of 16 hours), however infants who were more severely affected had better outcomes with the Small Step program
• Goal-Activity-Motor-Enrichment (GAME): there are two publications comparing GAME intervention with standard care; both significantly favouring GAME. In both studies,

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Case study – *continued: What intervention would be appropriate for Russell based on the evidence for intervention for infants with CP?*

Assessment considerations:
• Collaboratively set goals for both short term (the next 6 months) and longer term (12-18mths) development. During the goal setting phase your conversation could be structured using the F-words of childhood.
• Ask Russell's parents about his temperament or use a standardised measure of temperament – this is an unexplored area in our understanding of children with CP.
• Determine Russell's interest in toys and other aspects of his environment that will stimulate him to be an active learner. What will make his playtime fun? What songs/rhymes will encourage him to move?
• Map the infant's day using the DAIS so that the intervention fits with his family's function. Aim for random and variable practice; within and between days.

Intervention considerations:
• How is Russell positioned when engaged in unilateral or bilateral hand play. He might be appropriate for BIM or CIMT. Fine motor tasks that have a high degree of precision or accuracy (toys that are appropriate to the child's cognitive and functional ability) require more postural support. Increase postural support so that the child can achieve the task (toy-play) requirement to enhance the child's sense of success. Toy play that has fewer postural demands is an opportunity for the child to practice balance skills while playing. Likewise, a child who is listening

to a story may need more postural support to enable him/her to scan the pages of the book or to reach and touch the book.
• Vary the support surfaces Russell plays on to challenge his balance for gross motor tasks. Floor surfaces indoors and outdoors differ in texture, density and friction, requiring different degrees of motor control and motor planning. Encourage trial and error learning.
• Provide developmental intervention that addresses the infant's motor, cognitive, language and psychosocial development.
• Educate and coach his parents and his other carers so he has multiple opportunities for learning and engaging in his environment. Empower his carers to be aware of his efforts and ways to respond actively to his movement, play or social overtures.
• Adjust his goals and progress the complexity and challenge in his activities.
• Measure outcomes for the infant and the family, based on the F-words.
• Implement a fidelity check to track your intervention. The Template for Intervention Description and Replication (TIDieR) checklist is designed for authors to report their interventions, especially when described as »standard care«[7]. However, the components of this checklist are a useful format for documenting intervention in clinical settings.
• Comply with the WHO 24-hour guidelines for infant activity, sedentary behavior and sleep[8].

infants were enrolled at a mean age of 17wks corrected age, but study duration differed as did duration of intervention/day and over the course of the study. The authors conclude that intensity and specificity of practice are the differences between GAME and standard care

It is worthwhile considering the **Yellow light** interventions. Novak are not conclusive in their decision regarding these interventions[6]. As with all evidence, consideration should be given to the study design that might not be appropriate for testing a particular intervention. For example, inclusion/exclusion criteria of participants, and the length and dosage of the intervention might not have been adequate for motor learning. So rather than dismissing **Yellow** (and possibly **Red**) interventions, there may be features of these interventions that are consistent with motor learning and would bear consideration for a particular child or family.

Where to next for Early Intervention?

Stay tuned for the findings of a number of protocols that have been published of on-going studies: UP-BEAT *(Guzzetta et al. 2013),* REACH *(Boyd et al. 2017)* and e-Habit-ile *(Araneda et al. 2020).* There is also interest in novel interventions such as treadmill training *(Cochrane Library)* and contingency learning, and measures of activity using accelerometers and inertial measurement units.

Who to follow in Early Intervention for infants with or at risk of motor delay?

Australasian Cerebral Palsy Clinical Trials Network, University of Queensland, Australia have five themes that encompass the breadth of research in early intervention: 1. Epidemiology, pre-clinical and neuroprotection, 2. Early detection and neuroimaging, 3. Clinical trials, 4. Knowledge translation and implementation and 5. Engagement. The Director of this research group is Professor Roslyn Boyd.

Infant Action Lab at New York University conducts ground-breaking research that challenges common perceptions. One of Professor Karen Adolph's articles (in press) is titled »The impact of errors in infant development: Falling like a baby« – tempting!

Institute of Neuroscience, Université Catholique de Louvain, Brussels is where Professor Yannick Bleyenheuft conducts studies into intensive training HABIT-ILE for older children and e-Habit-ile for younger children.

Stella Maris Infant Lab for Early Intervention has a large body of work in early intervention, including the VISIBLE project for infants with vision impairments and is led by Professor Andrea Guzzetta.

En komplet referenceliste kan downloades på: http://www.boernefysioterapi.dk/om-os/born-i-fysioterapi/referencelister