






Interventions to improve physical function for children and young people with cerebral palsy: international clinical practice guideline

MICHELLE JACKMAN^{1,2}  | LEANNE SAKZEWSKI¹  | CATHERINE MORGAN³  | ROSLYN N BOYD¹  | SUE E BRENNAN⁴ | KATHERINE LANGDON⁵ | RACHEL A M TOOVEY⁶ | SUSAN GREAVES⁷ | MEGAN THORLEY⁸ | IONA NOVAK^{3,9} 

1 Queensland Cerebral Palsy and Rehabilitation Research Centre, Faculty of Medicine, University of Queensland, Brisbane, Queensland; **2** John Hunter Children's Hospital, Newcastle, New South Wales; **3** Discipline of Child and Adolescent Health, Faculty of Medicine and Health, Cerebral Palsy Alliance Research Institute, The University of Sydney, Sydney, New South Wales; **4** School of Public Health and Preventative Medicine, Monash University, Melbourne, Victoria; **5** Perth Children's Hospital, Perth, Western Australia; **6** Physiotherapy Department, University of Melbourne, Melbourne, Victoria; **7** Occupational Therapy Department, Royal Children's Hospital, Melbourne, Victoria; **8** Queensland Paediatric Rehabilitation Service, Brisbane, Queensland; **9** Faculty of Medicine and Health, The University of Sydney, Sydney, New South Wales, Australia.

Correspondence to Michelle Jackman at Paediatric Occupational Therapy Department, John Hunter Children's Hospital, Locked Bag 1, HRMC, NSW 2310, Australia. E-mail: Michelle.jackman@health.nsw.gov.au

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ABBREVIATIONS

CIMT	Constraint-induced movement therapy
CO-OP	Cognitive orientation to occupational performance
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HABIT-ILE	Hand–arm bimanual intensive training including lower extremity
ICF	International Classification of Functioning, Disability and Health
MACS	Manual Ability Classification System
PICO	Population, intervention, comparison, outcome
RCT	Randomized controlled trial

AIM To provide recommendations for interventions to improve physical function for children and young people with cerebral palsy.

METHOD An expert panel prioritized questions and patient-important outcomes. Using Grading of Recommendations Assessment, Development and Evaluation (GRADE) methods, the panel assessed the certainty of evidence and made recommendations, with international expert and consumer consultation.

RESULTS The guideline comprises 13 recommendations (informed by three systematic reviews, 30 randomized trials, and five before–after studies). To achieve functional goals, it is recommended that intervention includes client-chosen goals, whole-task practice within real-life settings, support to empower families, and a team approach. Age, ability, and child/family preferences need to be considered. To improve walking ability, overground walking is recommended and can be supplemented with treadmill training. Various approaches can facilitate hand use goals: bimanual therapy, constraint-induced movement therapy, goal-directed training, and cognitive approaches. For self-care, whole-task practice combined with assistive devices can increase independence and reduce caregiver burden. Participation in leisure goals can combine whole-task practice with strategies to address environmental, personal, and social barriers.

INTERPRETATION Intervention to improve function for children and young people with cerebral palsy needs to include client-chosen goals and whole-task practice of goals. Clinicians should consider child/family preferences, age, and ability when selecting specific interventions.

The estimated incidence of cerebral palsy (CP) ranges from 1.4 to 1.8 in 1000 live births in industrialized countries,^{1,2} with the prevalence being 2.95 to 3.4 per 1000 live births in low- and middle-income countries.^{3,4} CP is an umbrella term encompassing a heterogeneous group of permanent but not unchanging disorders of movement and posture that is caused by damage to the developing brain.⁵ In addition to movement difficulties, individuals may experience challenges with communication, behaviour, vision, hearing, feeding, pain, and sleep.⁶ The impact of CP on an individual extends across the lifespan, influencing

independence in activities of daily living, play, and participation in education, social, and community activities.⁷

Therapy interventions for children and young people with CP have evolved considerably over the past 20 years, in line with the World Health Organization's International Classification of Functioning, Disability and Health (ICF) framework. This evolution has seen a change of focus from primarily addressing underlying symptoms and impairments with the aspiration of improving function, to focusing instead on training activities and real-life tasks that are important to the person, plus directly targeting their full

participation within the community.⁸ Client-centred goals, direct active practice of the individual's goal and adaptation of the task and environment to suit the individual align both with personal and environmental factors of the ICF and tap into personal factors including motivation and individual interests. This holistic approach to targeting all modifiable factors that might influence outcomes is also aligned with the 'F words' for child development: function, family, fitness, fun, friends, and future.⁹

Interventions that aim to improve function are therapeutic approaches in which the child actively practises the goal or task they wish to achieve (known as 'goal-directed', 'task-based', or 'whole-task practice' approaches). These interventions encompass similar principles in which individual goals are set, and the goal or task is actively practised by the individual until the goal or desired 'functional' outcome is achieved in a holistic way. Examples of specific named interventions that are 'goal-based' include cognitive orientation to occupational performance (CO-OP), goal-directed training, goal-directed motor coaching, goal-directed home programmes, and hand–arm bimanual intensive training including lower extremity (HABIT-ILE). Examples of specific named interventions that are 'task-based' include bimanual training, constraint-induced movement therapy (CIMT), context therapy, hand–arm bimanual intensive training (HABIT), partial bodyweight-supported treadmill training (part-task), sit-to-stand training, task-orientated functional exercise, and treadmill training (part-task). Examples of specific named interventions that are 'whole-task practice' include overground walking. Interventions that improve function encompass goals within the 'activity' and 'participation' domains of the ICF, rather than addressing underlying impairments or goals within the 'body functions and structure' domain of the ICF (such as 'fitness'). For example, interventions that improve function do not aim to improve muscle tone, muscle strength, or joint range of motion; and while addressing these may be important for a child with CP, they are not the focus of this guideline (see Appendices S1–S3, online supporting information).

When aiming to improve functional goals, evidence suggests that the whole goal needs to be practised, ideally within a 'real world' context for skills to be effectively transferred to an individual's everyday life.^{10,11} For example, a child's goal of improving handwriting legibility would not focus on finger strength and pincer grasp. Instead, intervention to improve function would involve actual practice of handwriting, and take into consideration other factors that may be affecting the child's ability to produce written work at home and school (e.g. the pen or pencil the child is using, the chair or table they are seated at for writing, where the child is positioned within the classroom, literacy skills, as well as the child's motivation or the levels of 'fun'). In this way, intervention is not solely focused on the motor skill, but also takes into consideration the ICF personal and environmental factors that may be affecting achievement of the goal. If the child cannot

What this paper adds

- To improve physical function, intervention should focus on active practice of the client's goals.
- Best practice includes client-chosen goals and whole-task practice.
- Education and support need to be provided to empower families in decision-making.
- Child/family preferences, age, and ability need to inform choice of interventions.

complete the whole task, part-task practice could be conducted, followed by whole-task practice.

The aim of this guideline is to provide equitable and relevant recommendations based on the best available evidence to guide clinicians and inform families about the most appropriate interventions to improve function for children and young people with CP. This guideline places an emphasis on physical strategies because CP is a physical disability and most of the evidence has researched physical function. While cognitive, communication, and social functions are important, these are not the focus of this guideline.

METHOD

The Grading of Recommendations Assessment, Development and Evaluation (GRADE)¹² approach underpinned the guideline development. A technical panel comprising clinician-researchers and methodologists trained in Cochrane and GRADE approaches (Appendix S4, online supporting information) had oversight of the technical process of development (Appendix S5, online supporting information).

Wide international consultation was conducted at every stage of the guideline development with key stakeholders. Stakeholders included parents and consumers, specialist clinicians and researchers ($n > 600$) in three continents, and an international panel from high-, middle-, and low-income contexts. The guideline topic was nominated and prioritized by parents of children and young people with CP, researchers, and clinicians during a formal consultation process conducted by the International Alliance of Academies of Childhood Disability guidelines group in Vienna in 2014, San Diego in 2014, and an e-consumer survey in 2015. Parents rated improving function as their third highest priority for clinical guideline development (after early diagnosis and early intervention, which were addressed in separate publications). For each clinical question, the technical panel members conducted the search, critical appraisal, and summarized findings of the systematic review and the certainty of the evidence in GRADE Evidence Profiles.¹² Using the GRADE Evidence to Decision framework,^{13,14} recommendations were made by a multidisciplinary panel that included consumers and clinicians. The resulting draft guideline was reviewed by a 20-member international panel for feasibility, acceptability, affordability, and cultural sensitivity globally. The guideline development methods are reported in full in Appendices S4 to S6, Tables S1 to S3, and Figure S1 (online supporting information). A flow diagram of the development and consultation process is also provided (Fig. 1).

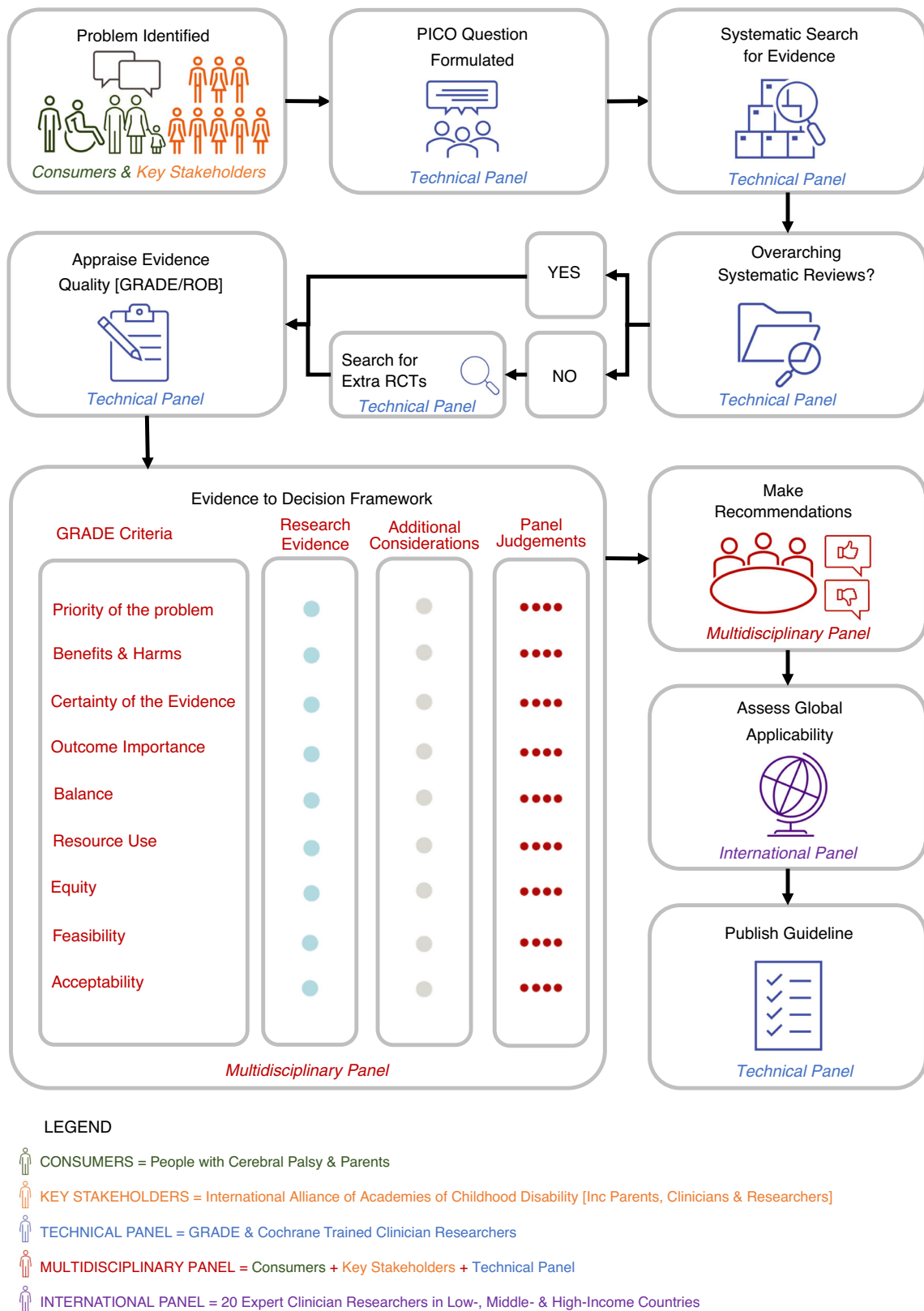


Figure 1: The guideline process. PICO, population, intervention, comparison, outcome; GRADE, Grading of Recommendations Assessment, Development and Evaluation; ROB, risk of bias; RCT, randomized controlled trial.

PICO

Our population, intervention, comparison, outcome (PICO) question was as follows. For children and young people with CP (P), which interventions to improve function (as defined in the introduction) (I), compared with alternative interventions or no intervention (C), improve outcomes in the activities or participation domains of the ICF (O)?

Eligibility criteria

Inclusion criteria for systematic reviews (which included randomized trials) and randomized trials were the following: (1) at least 80% of participants had CP; (2) at least 80% were aged between 2 and 18 years; (3) they evaluated interventions that aimed to improve physical function; (4) outcomes were measured using valid, reliable, and responsive measures at the activities and participation domains of the ICF.

Inclusion criteria for supplementary searches (if no relevant systematic reviews or randomized trials existed) included the following: (1) participants included children and young people with CP aged 2 to 18 years; (2) reliable research methods were evident; (3) studies evaluated interventions that aimed to improve physical function.

Where duplicate or similar systematic reviews existed, we selected one systematic review that best answered our PICO. A review was deemed to be superseded if there was a newer review that included the same randomized controlled trials (RCTs) or was more comprehensive. When an RCT was missing from an overarching systematic review but was included in other reviews, these extra RCTs were extracted and added to the body of evidence under examination. See Appendix S5 for further detail.

Search

We systematically searched the Cochrane Library, CINAHL, Embase, and MEDLINE up to November 2018 to capture existing guidelines, systematic reviews (including RCTs), and RCTs that answered our PICO question. Supplementary searches were done where higher-quality evidence was unavailable or the systematic review did not fully answer our PICO question. Search terms are available in Appendix S6. An updated search of systematic reviews and randomized trials only was done in May 2021.

Study selection and data extraction

Two reviewers independently performed study selection, data extraction, and risk-of-bias ratings. The methodological quality of studies chosen as primary evidence was assessed (Table S1): overarching systematic reviews (which included primary RCTs) using the revised A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2);¹⁵ randomized trials using the Cochrane Risk of Bias-2 (RoB 2);¹⁶ and non-randomized studies using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I).¹⁷

Data synthesis

Selection of evidence was based on alignment of the study with the PICO questions, how up to date the systematic review (which included RCTs) was, and the methodological quality. Characteristics of included studies and risk-of-bias assessment were tabulated (primary evidence [Table S1]; other included studies [Table S2]; excluded studies [Table S3]). Certainty of evidence was assessed and tabulated in GRADE evidence profiles (Appendices S7–S10, online supporting information). If randomized trials had sufficiently similar characteristics, meta-analyses were performed.

Evidence-based recommendations

The GRADE Evidence to Decision framework was used to develop recommendations, considering the balance of benefits and harms, certainty of evidence, patients' values and preferences, resources, equity, acceptability, and feasibility. The guideline multidisciplinary panel, which included consumers, clinicians, and technical methodologists, considered evidence and other information in relation to each of these Evidence to Decision criteria to decide on the direction (for or against an intervention) and the strength (strong or conditional) of each recommendation.^{18,19} For each area of function, the panel made recommendations at two levels. First, the panel made a general recommendation considering the totality of evidence across interventions that aim to improve function versus no intervention (e.g. for or against mobility training). Second, specific recommendations were made for each of the interventions for which there was evidence (overground walking, treadmill training, etc.). The evidence, information, and panel's judgements are summarized in a single Evidence to Decision framework for each function (shown in Appendices S7–S10). Strong recommendations are made for interventions where the benefits clearly outweigh the harms (including high or moderate certainty evidence, and for which most individuals [children/young people and families] would place similar values on the outcomes of the intervention), and where other factors favour the use of the intervention. In essence, a strong recommendation in GRADE means that most health professionals should follow the recommendation and most individuals would want the recommended action: the intervention is considered essential. Conditional recommendations are those for which there is a closer balance between the benefits and harms (including lower certainty of evidence, variability, or uncertainty about the value individuals place on the outcomes of the intervention), where there may be cost implications, and shared decision-making is essential because different choices of interventions may be appropriate for individuals (children/young people and families).

Good practice recommendations

The multidisciplinary panel drafted good practice recommendations for questions outside the scope of the

systematic review, following the GRADE approach for ungraded recommendations.²⁰ The panel based these recommendations on their consensus views of currently accepted ethical and healthcare standards for children and young people with CP. These were reported separately.

RESULTS

The guideline comprises 13 recommendations: four evidence-based graded recommendations (three systematic reviews inclusive of randomized trials, 30 randomized trials, and five before–after studies) and nine ungraded good practice recommendations. Search results are summarized in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Fig. S1).

We present broad recommendations for each functional goal, followed by more specific recommendations about

intervention options. Recommendations are summarized in Tables 1 and 2.

GOOD PRACTICE RECOMMENDATIONS

General principles to improve the process and content of care when working with children and young people with CP and their families are recommended for addressing functional goals. These recommendations are relevant to all subtypes of CP. Clinical reasoning and decision-making should always involve weighing up individual children and young people's and families' preferences, context, clinical and health system affordances, plus the certainty of the evidence. Depending on the circumstances and context, it may only be possible to follow some, rather than all, of these recommendations; this decision should be grounded in good clinical reasoning. It is likely that knowledge

Table 1: Good practice recommendations for interventions to improve physical function for children and young people with cerebral palsy

Recommendation 1: Client-chosen goals should be set

- Intervention should always begin with understanding the child's functional goals. If the child is unable to identify their own goals, families should be engaged to set goals considering the child's preferences and interests
- Goals should be functional, well defined, achievable, and measurable
- Goals should be incremented according to the child's level of ability and progress
- A written copy of the goals should be provided to the child/family
- Goal performance should be measured at the beginning and completion of the intervention

Recommendation 2: Clinicians should determine the factors that are limiting goal achievement

- Clinicians should observe the child carrying out the task/goal to determine the specific skills or barriers that are limiting goal achievement

Recommendation 3: Intervention should directly target the child's chosen goals

- Intervention should involve active practice of the goal. Clinicians should use a 'hands-off' approach as much as possible, providing opportunities for the child to actively and independently practice the task they wish to achieve
- Clinicians can assist children and young people by encouraging child-led problem-solving, identifying where task achievement is unsuccessful, and providing feedback on how task performance can be improved
- If the goal is broken down into part-task practice, intervention should be followed by whole-task practice of the goal once the child is ready to do so

Recommendation 4: Intervention should be enjoyable and motivating for the child

- If the child is crying or distressed, the clinician should stop, comfort the child, and change the intervention to match the child's ability, needs, and preferences

Recommendation 5: Practice of goals should occur within the child's home or community environments

- Functional training is maximized by considering the context of practice. Achievement of the goal is more likely to be carried over into everyday life if it is practised within everyday environments, such as the child's home or community
- When this is not possible, practice should occur within an environment that simulates real-life as much as possible
- Recommendations for practice at home should be given in written or visual formats

Recommendation 6: Parent-delivered intervention is a key component of all intervention

Clinicians should provide the following:

- Education, coaching, and information to support caregivers to be actively engaged in the intervention, including encouraging autonomy, problem-solving, and task-specific practice of goals
- A structured home programme, which involves practice of the child's chosen goals
- Ongoing review as well as child and family support

Recommendation 7: Children and young people and parents should remain the decision-makers throughout

- Clinicians have a responsibility to provide families with up-to-date evidence, to enable them to make informed decisions about the best intervention for their child
- Parental engagement is a key factor in the success of an intervention
- Intervention recommendations should be tailored to match the child's functional ability and potential
- Timing and content of interventions should consider individual factors, such as age, ability level, resources, and individual child and family preferences
- Only feasible, acceptable, and effective interventions should be recommended and/or performed

Recommendation 8: A high enough dose of practice needs to be undertaken to achieve functional goals

- Clinicians should consider how an optimum dose can be achieved when planning intervention, including face-to-face therapy and home practice
- The optimum dose may vary depending on the child, the complexity of the goal, the type of intervention chosen, and context/resources

Recommendation 9: A team approach should be used to set goals and the intervention regimens

- A team approach (including the child and family as team members) to setting goals and making decisions about intervention regimens can streamline services and prevent overburdening of families

Table 2: Evidence-based practice recommendations for interventions to improve physical function for children and young people with cerebral palsy (CP)

Evidence-based practice recommendations	Strength of recommendation and quality of evidence
<p>Recommendation 10: Mobility To improve mobility in children and young people with CP (GMFCS I–IV, all motor subtypes) we recommend mobility training using a goal-directed approach, with a focus of practice within a real-life context, compared with no intervention</p> <p>10.1 Walking speed and endurance To improve walking speed and endurance in children and young people with CP, we suggest overground training (with or without a walker) (GMFCS I–IV), treadmill training (GMFCS I–III), and HABIT-ILE (GMFCS I–IV), compared with no intervention OR body functions and structure intervention</p> <p>10.2 Gross motor function To improve functional mobility goals and balance in children and young people with CP, we suggest goal-directed training (GMFCS I–III) and HABIT-ILE (GMFCS I–IV), compared with no intervention OR body functions and structure intervention To improve gross motor function in children and young people with CP (GMFCS I–IV), we suggest either altering environmental factors (e.g. ‘context focused’) OR child-focused therapy (i.e. treatments that alter child-related factors) We suggest clinicians consider the child’s age, ability, and child/family preferences and tolerance of adjunctive interventions when selecting interventions</p>	<p>Strong recommendation for mobility training as there is high certainty of harm from no intervention^a</p> <p>Conditional recommendation for overground walking, treadmill training, goal-directed training, HABIT-ILE, and context-focused</p> <p>Moderate certainty for overground training</p> <p>Low certainty for treadmill training, goal-directed training, HABIT-ILE, and context-focused</p>
<p>Recommendation 11: Hand use To improve goal achievement in hand use in children and young people with CP (MACS I–IV, all motor subtypes), we recommend a goal-directed or task-specific approach, compared with no intervention OR body functions and structure intervention</p> <p>To achieve functional upper-limb goals in children and young people with unilateral CP, we recommend CIMT, bimanual therapy/HABIT (MACS I–III), and we suggest CO-OP and HABIT-ILE (MACS I–IV) compared with no intervention OR body functions and structure intervention^b</p> <p>To achieve functional hand use goals in children and young people with bilateral CP, we suggest HABIT/HABIT-ILE (MACS I–III) and CO-OP (MACS I–IV) compared with no intervention OR body functions and structure intervention^b</p> <p>To improve hand use in children and young people with CP classified in MACS level IV (unilateral or bilateral), we suggest a goal-directed focus plus environmental adaptations and equipment/assistive technology to maximize independence, compared with no intervention OR no equipment/assistive technology OR body functions and structure intervention^b</p> <p>We suggest clinicians consider the child’s age, ability, context/resources, and child/family preferences and tolerance of adjunctive interventions when selecting interventions</p>	<p>Strong recommendation for CIMT and bimanual</p> <p>High certainty for CIMT. Moderate certainty for bimanual training/HABIT</p> <p>Conditional recommendation for CO-OP, goal-directed, and HABIT/HABIT-ILE</p> <p>Low certainty for CO-OP, goal-directed, and HABIT/HABIT-ILE</p>
<p>Recommendation 12: Self-care To improve self-care goal achievement in children and young people with CP (all motor types and severities), we recommend a goal-directed and task-specific approach (for skills development) plus adaptive equipment (for safe, timely independence), compared with no intervention</p> <p>To improve self-care skills in children and young people with CP (GMFCS I–IV, all motor types), we recommend goal-directed training, CO-OP, and HABIT, compared with no intervention or body functions and structure intervention,^b and we suggest HABIT-ILE (GMFCS I–IV, all motor types)</p> <p>To improve independence, safety, and decrease caregiver burden during self-care tasks for children and young people with CP (GMFCS IV and V, all motor types), we suggest adaptive equipment</p>	<p>Strong recommendation as there is high certainty of harm from no intervention^a</p> <p>Moderate certainty for context-focused, goal-directed training and HABIT. Low certainty for CO-OP,^a HABIT-ILE</p>
<p>Recommendation 13: Leisure To improve performance of a leisure activity in children and young people with CP, we suggest clinicians combine goal-directed approaches (CO-OP, goal-direct training, HABIT-ILE for GMFCS I–IV; and goal-directed training for GMFCS V) with a focus on supporting the individual to overcome environmental, personal, and social factors that may limit participation, compared with no intervention or body functions and structure intervention^b</p>	<p>Conditional recommendation</p> <p>Most individuals would choose this option; however, there is limited direct evidence</p> <p>Low certainty</p>

^aA strong recommendation was assigned because this clinical problem area is always a high priority for families and there is high-quality evidence of harm from no intervention (in population register studies) including decline in musculoskeletal deformity, walking, and self-care skills when these interventions to improve are not in use. ^bMore detailed information on comparator interventions are available in the Evidence to Decision Appendices S7–S10 (online supporting information). GMFCS, Gross Motor Function Classification System; HABIT-ILE, hand–arm bimanual intensive training including lower extremity; MACS, Manual Ability Classification System; CIMT, constraint-induced movement therapy; CO-OP, cognitive orientation to occupational performance.

translation efforts will be needed by the field to overcome health system barriers that limit implementation of these recommendations (e.g. availability of intensive therapy).

Good practice recommendation 1

***Client-chosen goals should be set*^{21–24}**

Intervention should begin with understanding the children and young people's goals to harness the ICF personal factor of motivation and interests. Inviting children and young people to identify the functional skills and abilities that are most important to them, then setting small, realistic goals, can improve motivation and outcomes.²⁵ If the child is unable to identify their own goals (owing to age or ability), goals should be discussed with families ('family').

Some children and young people and families may find setting goals challenging, particularly if they have no experience, or a cultural preference for expert-delivered care. Therapists can discuss what is realistic for the child on the basis of their ability level while ensuring the child's interests and preferences are included when setting goals. For younger children, caregivers may need information about realistic developmental and prognostic trajectories ('family'). To identify goals, clinicians can discuss the child's 'typical' daily routine, or use a standardized tool such as the Canadian Occupational Performance Measure.²⁶ It is important to consider activities the child enjoys or wishes to participate in ('fun'), and that are most important to them. Goals should be specific and measurable, such as the SMART (specific, measurable, achievable, realistic, timely) goal format.²⁷ Clinicians should set a time-frame within which the goal is achievable, and measure the goal at the beginning and end of intervention with feedback to the family because this promotes adherence, satisfaction, and adequate intensity of practice.²⁸

Good practice recommendation 2

***Clinicians should determine the factors that are limiting goal achievement*¹⁰**

Once the child has identified their goals, clinicians should carry out structured observations and task analysis of the child attempting their goal. Clinical reasoning is then used to determine the factors that are limiting goal achievement and to identify the task components or specific skills that need to be targeted, while considering barriers (including environmental and social barriers and/or body functions and structure).

Good practice recommendation 3

***Intervention should directly target the child's set goals*¹⁰**

Intervention should focus on actively practising the goals, rather than attempting only to address underlying impairments (such as muscle weakness, joint range of motion, or proprioception). A child's active practice involves a 'hands-off' therapy and coaching approach, allowing them to self-initiate and perform tasks to their full potential.¹⁰ When the child is unable to practise the whole task, part-task practice may be undertaken as a first step towards whole-

task practice. Providing feedback to the child is an important part of learning a new task or skill.^{29,30} Feedback can be provided verbally or may involve child-led problem-solving as a part of the intervention. Feedback can be inherently built into task practice so that the child knows when they have succeeded.

If a body functions and structure barrier to goal performance is identified, intervention might include a body functions and structure intervention paired with task-specific training to support task performance. For example, if the goal was to play tennis and one of the goal-limiting factors was that the child could not sustain their grip of the racket, grip strength training might be paired with practice in maintaining a grip of the racket while playing tennis.

Good practice recommendation 4

***Intervention should be enjoyable and motivating for the child*^{28,31,32}**

Intervention should involve enjoyable, motivating, and challenging activities. If the child is crying or distressed, the clinician should stop, comfort the child, and change the intervention to match the child's needs and preferences. If the intervention is painful and/or distressing, it is not recommended.

Good practice recommendation 5

***Practice of goals should occur within the child's home or community environments where possible*¹¹**

The child is more likely to be able to achieve their goal in everyday life if it is actually practised within their home or community. When this is not possible, practice should occur within an environment that simulates real-life as much as possible. This may include practice of the whole task within the clinic environment, or similar environment (e.g. an outdoor space if the goal is an outdoor activity). Children and young people and families can bring resources for goal practice into the clinic (e.g. if the goal is improving basketball skills, the child can bring the ball they use at home/school). Clinicians can plan with the child and family how and when practice can be undertaken during the family's daily routine.²⁸ This will facilitate carry-over of skills into everyday life.

Good practice recommendation 6

***Parent-delivered intervention can be used to supplement face-to-face therapy when appropriate education is provided*³³**

Parent-delivered intervention is recommended as an important supplement to face-to-face therapy. To support a home programme, clinicians should (1) establish a collaborative partnership with the family; (2) empower the child and family to set their own goals for intervention; (3) provide a list of feasible and enjoyable activity ideas and resources in written format with photographs, ideally of the child doing the task, that can be done at home; (4) demonstrate, educate, and coach parents on how to

support practice at home; and (5) check in regularly with families (telephone, video, e-mail, or face-to-face) to provide support and update the programme as needed.³³ Parent-delivered interventions may be particularly important in underdosed models of healthcare.³⁴ It is also important for therapists to support parents to remain in the role of parent, and not become a therapist at home ('family'). Some families may find it preferable for the intervention to be clinician-delivered so as not to disrupt family routines and roles. Clinicians should adapt the intervention plan according to family preferences.

Good practice recommendation 7

***Children/young people and parents should remain the decision-makers throughout*^{28,35,36}**

Clinicians should provide families with up-to-date evidence, to enable families to make informed decisions about the best intervention for their child. In addition to considering the child's goals, age, and ability level, families should be invited to develop their own ideas about how to achieve the goals and to consider the most important people in the child's life to support learning. Parental engagement is a key factor in the success of an intervention ('family'). Building a strong relationship between the clinician, child, and family, and allowing children and young people and families to be actively engaged in decision-making, leads to better clinical outcomes.²⁸ Clinicians should empower parents to understand that choosing not to do certain interventions or using compensatory approaches such as equipment and environmental adaptation is not giving up; rather, it is facilitating increased independence and respect for the child's time and preferences. Clinicians should not recommend interventions known to be ineffective or unsuitable to the child's functional abilities.

Good practice recommendation 8

A high enough dose of practice needs to be undertaken to achieve functional goals

It is important to consider dose of practice when making a decision about intervention options as different interventions may require more or less practice to be successful. Clinicians and families may need to plan how the effective dose will be achieved. Clinicians should inform families when an intervention is unlikely to be successful if their child does not practice enough to reach the threshold dose. For interventions aimed at improving function, the threshold dose is the amount of practice needed to achieve a goal. In many settings, 'intensive' or 'high-dose' interventions may not be realistic, often because of historical models of service and/or funding constraints. Therapists and families should discuss how threshold doses can be reached through a combination of face-to-face therapy and families providing the other necessary portion of the known effective dose. Providing underdosed services is not recommended and is potentially an ineffective use of the child's time and the health system's finances.

To achieve functional goals, goal-directed training, in which the whole goal is practised, is recommended. Goal-directed training is feasible, even in settings where high-dose or high-intensity interventions are not affordable or available. The optimum dose of intervention will vary depending on the individual, the complexity of the goal, and the type of intervention. As a general guide, a threshold dose of 15 to 25 hours of goal practice may be needed (for three upper-limb goals).³⁷ More than half of this can be family-led practice.³⁷ If the goal of intervention includes more generalized improvement of motor ability (rather than a specific functional goal) it is likely that a threshold dose of over 40 hours of practice is needed.³⁷ An intensive block of therapy is recommended over regular low-dose distributed therapy, as children and young people may find it easier to learn a new skill within a dedicated timeframe. Practice and progress can be tracked by a logbook or reward chart.

The natural history of CP involves physical decline with age. Mobility and self-care skills are known to be particularly vulnerable to decline, and regular use of these skills at a high enough dosage will be required for maintenance of skills. Furthermore, some body functions and structures, such as muscle strength and 'fitness', also decline with sedentary behaviour and may require intervention so as not to confound goal achievement.

Good practice recommendation 9

***A team approach should be used to set goals and intervention regime*³⁸**

Multidisciplinary/interdisciplinary teamwork can streamline services and prevent overburdening of families. As children and young people have needs across many areas and disciplines, child-led goal-setting, prioritization, and intervention should occur as a team, rather than multiple single-discipline goals being practised in isolation. It is recommended that the child (rather than clinicians) prioritizes three goals, and the appropriate clinicians support intervention planning. Once these goals have been achieved, new goals can be set.

EVIDENCE-BASED RECOMMENDATIONS

Evidence-based recommendation 10

Gross motor function and mobility

To improve mobility in children and young people with CP (classified in Gross Motor Function Classification System [GMFCS] levels I–V, all motor subtypes), we recommend mobility training using a goal-directed approach, with a focus on whole-task practice within a real-life contexts, compared with no intervention.

Strong recommendation based on high certainty evidence of harm from no intervention

Walking speed and distance. When aiming to improve walking speed and distance for children and young people classified in GMFCS levels I to III, we suggest the practice of

walking.^{39,40} Treadmill training can increase the dose of walking practice if this equipment is available.

General mobility training, overground walking, and sit-to-stand training may improve walking speed and distance.^{39–42} These interventions should be supplemented with practice of walking within the child's real-life environments and terrains.

For children and young people classified in GMFCS levels IV and V, overground walking practice is more effective than partial bodyweight-supported treadmill training for improving walking distance, but both treatments provide the experience of supported walking and will not lead to independent walking. For children and young people classified in GMFCS levels IV and V, the experience of walking might be a well-being and inclusion goal, rather than a functional mobility goal ('friends'). Despite this, partial bodyweight-supported treadmill training may lead to improved transfer abilities. In low- to middle-income contexts, whole-task practice is more affordable and feasible than partial bodyweight-supported treadmill training and is therefore preferentially recommended in these contexts.

Gross motor function. When aiming to improve gross motor function for children and young people classified in GMFCS levels I to III, goal-directed or task-specific training in which the whole task or goal is practised is suggested. Part-task practice may be undertaken as a first step towards whole-task practice.

HABIT-ILE,^{43,44} context-focused therapy,^{45,46} and goal-directed motor training^{47,48} can also be used to improve gross motor function in children and young people classified in GMFCS levels I to IV.

Independent mobility for children and young people classified in GMFCS level IV should focus on adaptive equipment (e.g. powered mobility) that supports effective and efficient goal achievement, rather than focusing on general gross motor skills. For children and young people classified in GMFCS levels III to IV, we recommend that functional goals be addressed in combination with equipment, technology, and environmental adaptations to maximize independence, inclusion, speed of task completion, and to reduce energy consumption and caregiver burden. We recommend that the child sets specific and achievable mobility goals and directly practises these (e.g. reposition themselves in bed).

More detailed recommendations to improve functional mobility are provided in Appendix S7.

Evidence-based recommendation 11

Hand use in functional activities

To improve goal achievement in hand use in children and young people with CP (in Manual Ability Classification System [MACS] levels I–IV, all motor subtypes), we recommend a goal-directed or task-specific approach, compared with no intervention *or* body structures and function intervention.

Strong recommendation based on low to high certainty evidence

For all children and young people with CP who have goals related to use of their hands, a goal-directed approach involving whole-task practice is recommended (e.g. training the whole task of handwriting, not training finger dexterity, and assuming this will transfer to improved handwriting). There are numerous effective intervention options, and the choice will depend on the child's cognitive ability, motor-type, topography, goal, child and family preferences, and available resources.

For children and young people classified in MACS level IV, clinicians should use goal-directed training and consider environmental adaptations and equipment that can increase the child's independence and decrease caregiver burden.

An upper-limb decision algorithm (Fig. 2) has been developed to guide clinicians, although individualized clinical reasoning should always take precedence.

For children and young people with unilateral or asymmetric CP, in MACS levels I to III, intensive models of CIMT and bimanual therapy lead to similar sized improvements,⁴⁹ but CIMT will produce unimanual improvements whereas bimanual therapy will produce bimanual improvements. This means the goals for intervention must be considered. When both unimanual and bimanual outcomes are sought, families can choose the approach that suits them best. When using either approach, the intervention should be targeted at the desired goals and followed by whole-task practice of the child's goals.

CIMT may be the most appropriate intervention option when the child is unable to use their more affected hand as an effective 'helper hand', and they can tolerate a restraint.⁴⁹ Intervention should not aim for the child to be able to use their more affected hand equally as well as their preferred hand because in most real-life tasks the dominant and non-dominant hands take different roles and have different skill levels. CIMT trials have mostly included children with active wrist extension and ability to grasp.⁴⁹ Caution using CIMT is warranted in children and young people with limited hand function, as frustration can arise and the age appropriateness of simple one-handed actions and activities should be considered. In children younger than 2 years of age, lower doses of CIMT are recommended to safeguard the development of the dominant hand.

There is limited benefit to wearing the restraint unless targeted task practice is undertaken concurrently.⁴⁹ Similar improvements occur from mitts, slings, splints, or casts, with removeable soft restraints preferred by children. The child should be given as much control as possible over the type of constraint chosen (e.g. choice of material or colour). If the child is distressed by the restraint, a different approach should be used (i.e. bimanual therapy or goal-directed training). CIMT should always be followed by whole-task practice without the restraint.

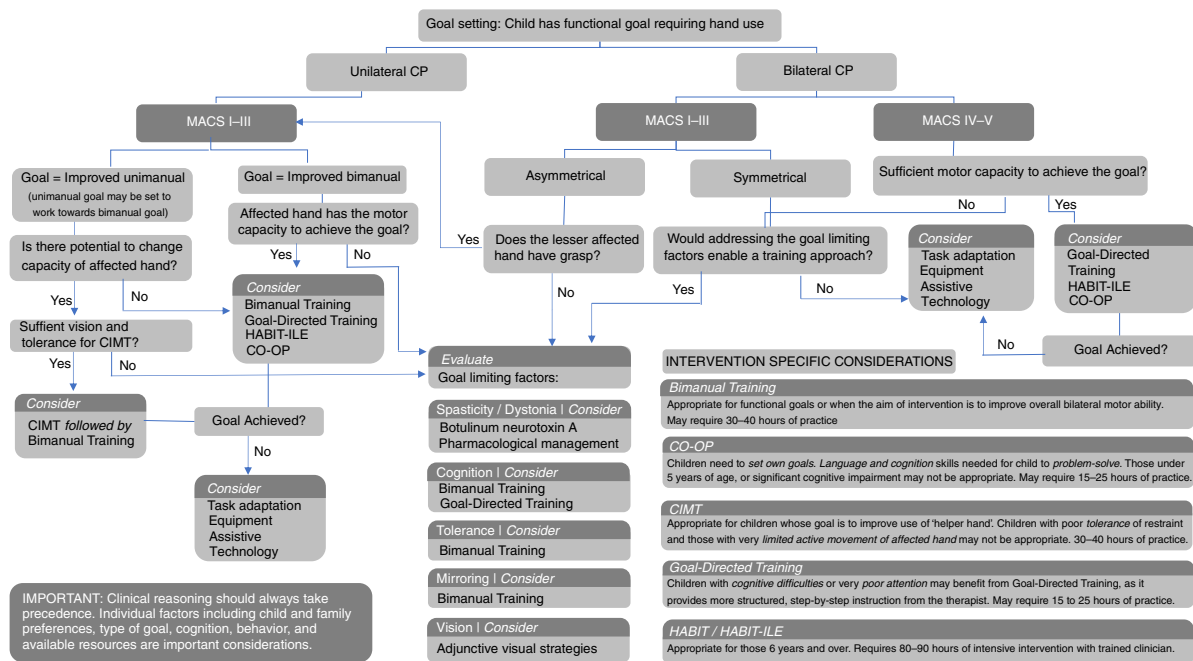


Figure 2: Decision algorithm for hand use in functional activities.

Bimanual therapy involves selecting activities and setting up the environment to promote spontaneous use of both hands, and negate the need for verbal or physical prompts. Activities and games need to be carefully selected to promote bimanual hand use while concurrently considering the role of the more affected hand when completing the desired bimanual activity (e.g. stabilization by weight/support, stabilization by grip or manipulation). HABIT/HABIT-ILE are two protocolized versions of bimanual therapy.^{43,50} Similar to CIMT, bimanual therapy should be followed by whole-task practice of the specific goal.

For children and young people with bilateral CP, there is emerging research into effective therapies to improve hand function. We recommend using a goal-directed training approach, in which the focus of intervention is whole-task practice (all ages, MACS levels I-IV) or CO-OP⁵¹ (aged >4y, MACS levels I-IV), HABIT-ILE⁴⁴ (aged >6y, GMFCS levels I-IV, MACS levels I-III), or HABIT⁵² (aged >4y, GMFCS levels I-IV, MACS levels I-III) to achieve hand function goals.

More detailed recommendations to improve hand use are provided in Appendix S8.

Evidence-based recommendation 12

Self-care

To improve self-care goal achievement in children and young people with CP (all motor types and severities), we recommend a goal-directed and task-specific approach (for

skills development) plus adaptive equipment (for safe, timely independence), compared with no intervention.

Strong recommendation based on high certainty of harm from no intervention

Goal-directed and task-specific training can lead to achievement of self-care goals and is recommended over interventions that address underlying impairments. CO-OP, HABIT, and goal-directed training are all effective goal-directed and task-specific approaches.^{33,43,51,53} Environmental adaptations and equipment that can complement the task-specific approaches to achieve goals are recommended but may not be available in low-income contexts.

CO-OP is feasible with children with all subtypes of CP older than 4 years,^{51,53} MACS levels I to IV, with verbal communication (or communication device), and problem-solving skills. Importantly, CO-OP seems to be beneficial for children with dystonic CP.⁵⁴

HABIT or HABIT-ILE is suggested because it is feasible with children classified in GMFCS levels I to IV with all subtypes of CP older than 4 years, and may lead to improvements in overall motor ability, self-care, and individual goal achievement.^{43,44} HABIT and HABIT-ILE are high-intensity approaches that require a high dose (90h over 10d) to be effective. CO-OP requires a lower dose of intervention than HABIT and HABIT-ILE, and therefore may be more feasible and cost effective. If the therapist is not certified in CO-OP, or trained in HABIT or HABIT-ILE, goal-directed training is recommended.

More detailed recommendations to improve self-care goals are provided in Appendix S9.

Evidence-based recommendation 13

Leisure

To improve performance of a leisure activity in children and young people with CP, we suggest that clinicians combine goal-directed approaches (CO-OP, goal-directed training, HABIT-ILE for GMFCS levels I–IV; and goal-directed training for GMFCS level V) with a focus on supporting the individual to overcome environmental, personal, and social factors that may limit participation, compared with no intervention or body functions and structure intervention.

Conditional recommendation based on low certainty evidence

Children and young people with CP participate in leisure activities less than their peers^{55–57} and the variety of leisure options is limited. When leisure is the focus, intervention should include child-chosen goals, identification of individual, social, and environmental barriers (‘friends’), motivational interviewing, whole-task practice within real-life environments, and environment-focused strategies including equipment prescription and site visits. ParticiPate CP⁵⁸ and the Pathways and Resources for Engagement and Participation have been shown to lead to improvements in individual participation goals,⁵⁹ as has intervention that directly addresses environmental and social barriers using a coaching approach.⁶⁰ Research focusing broadly on participation recommends that impairment focused interventions should not be used, and that intervention should be goal-directed and family-centred.^{61,62}

It is important that leisure goals are chosen by the child and done for enjoyment (‘fun’), and that the focus is on participation outside of the therapy environment (‘friends’).

More detailed recommendations to improve leisure goals are provided in Appendix S10.

Children and young people with severe motor impairment

It is acknowledged that children and young people with severe motor impairment (in GMFCS level V or MACS level V) are unlikely to benefit from training interventions to improve function, although it is important to recognize that children and young people with severe impairment can contribute to everyday tasks through small actions, and changing environmental factors through adaptive equipment can support function and inclusion.⁶³ Comorbidities in children and young people with severe motor impairment can affect function and may need to be medically managed for functional goals to be realized. Although not the focus of this guideline, interventions to reduce pain, manage seizures, improve nutrition, and reduce vomiting may reduce hospital admission and make learning more successful, thus fostering participation in everyday activities. Children and young people with severe physical disabilities benefit from adaptive equipment and assistive

technology to support their full inclusion within functional activities. It is acknowledged that adaptive equipment and assistive technology may not be affordable or available in low- to middle-income contexts, which may substantially curtail the child’s inclusion. Adaptive equipment and assistive technologies are discussed within the adjunctive interventions overview of the evidence table (Appendix S1) but are not a focus of this guideline.

Adjunct, body functions and structures, and complementary and alternative medicine interventions

International consultation with key stakeholders identified that clinicians often seek evidence about commonly used interventions that do not meet our definition of interventions to improve function, and which are therefore excluded from this guideline. To address this need, supplementary information has been developed to provide an overview of adjunctive interventions, which are concurrent interventions that might boost functional effects (Appendix S1), body functions and structure interventions (Appendix S2), and complementary and alternative medicines, which parents often seek to trial (Appendix S3). They are based on current best available systematic reviews and RCTs, retrieved using a systematic search and reported in an overview of systematic reviews.⁶⁴

DISCUSSION

No clinical practice guideline has ever focused on physiotherapy and occupational therapy for improving physical function in children and young people with CP at the activities and participation level of the ICF, even though it had been a priority identified within the field.⁶⁵ This guideline provides practical and accessible recommendations that clinicians across the world can perform to align their practice with the World Health Organization’s ICF framework. When the aim of intervention is to improve physical function for children and young people with CP, the following nine important elements should be included. (1) Client-chosen goals should be set to identify meaningful tasks and harness motivation. (2) Clinicians should observe the child attempting their functional goal to determine the factors that are limiting goal achievement. (3) Intervention should focus on whole-task practice of the goals to improve task performance. (4) Intervention should be enjoyable and motivating to harness plasticity. (5) Practice of the goals should occur within real-life environments (or simulate the child’s real-life environment as much as possible) to expedite generalization. (6) Support should be provided to families to facilitate practice at home to increase the dosage of practice. (7) Clinicians should inform and empower children and young people and families to make their own decisions about interventions to respect preference and foster engagement. (8) A high enough dose of practice should be planned for goals to be achieved to achieve clinically meaningful gains and harness plasticity. (9) A team approach to goal-setting and intervention should be used for streamlining services and enhancing communication.

To improve mobility outcomes, direct practice of the mobility goal should be undertaken. When the goal is walking, overground walking is recommended to improve walking distance and speed. Treadmill training (where available) can be an effective supplement to overground walking to increase the dose of practice for improving walking speed. To improve hand use outcomes, CIMT, bimanual therapy (including HABIL/HABIL-ILE), and CO-OP are effective approaches. For learning self-care skills and improving independence in self-care outcomes, goal-directed training, CO-OP, and HABIL/HABIL-ILE are potential options, supplemented by adaptive equipment (where available) to improve safety and lower caregiver burden. To improve leisure performance and participation, task-specific practice should be combined with supporting the individual to overcome environmental, personal, and social barriers to achieve participation. Factors including age, cognitive and functional ability, individual preferences, policies, and available resources will guide the most appropriate intervention approach for the child's chosen goal.

This review has several limitations. There were no existing systematic reviews that addressed our overarching clinical questions. As such, multiple systematic reviews and clinical trials were identified using a systematic review methodology, appraised and interpreted to develop these guidelines. Good practice recommendations are based on best available evidence; however, many of these principles have not been verified in high-quality trials. The senior authors resided within Australia, and although over 400 non-Australian clinicians were consulted and 19 non-Australian authors reviewed the manuscript, this may be a cultural limitation for implementing recommendations in all global contexts.

CONCLUSION

When aiming to improve functional goals for children and young people with CP, it is best practice for client-chosen goals to be set, and for intervention to be focused on whole-task practice of the goals, rather than addressing underlying impairments. Setting functional goals, and directly practising those goals, is a low-cost approach to intervention that can be applied across many settings, including those where resources are limited.

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DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

SUPPORTING INFORMATION

The following additional material may be found online:

Figure S1: PRISMA flow diagram of evidence.

Table S1: Included studies chosen as primary evidence

Table S2: Included studies not selected as overarching primary evidence

Table S3: Excluded studies with reason for exclusion

Appendix S1: Adjunct interventions.

Appendix S2: Body structures and function interventions.

Appendix S3: Complementary and alternative medicine interventions.

Appendix S4: Stakeholders, review process, and managing conflict of interest.

Appendix S5: Methods.

Appendix S6: Search terms.

Appendix S7: Mobility (including transfers).

Appendix S8: Hand use functional activities.

Appendix S9: Self-care.

Appendix S10: Leisure.

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