MassGeneral Hospital *for* Children℠

Pediatric Stroke Rehabilitation Workshop

How do we use research to guide our therapies?

Brian D. wishart, DO, mms, Faap

Massachusetts general hospital for children

Harvard medical school

Spaulding rehabilitation Hospital

The Challenge

- Very little related to pediatric stroke
  - Some things can be adapted from adult literature
  - Remains unclear if children recover better than adults after stroke
  - Trajectories and recovery patterns are most likely different
- Plenty of literature related to cerebral palsy
  - Only addresses the motor deficits
  - Still important as hemiplegia seen in 50-80% of chilren
  - Does not address cognitive impairments

The Challenge

- Current reviews and guidelines
  - Limited by mixed populations
  - Stroke, CP, acquired brain injury
- Much of literature pertains to acute management, etiology and outcomes

European Journal of Pediatrics (2019) 178:433–454
https://doi.org/10.1007/s00431-019-03350-7

REVIEW

Nonpharmacological rehabilitation interventions for motor and cognitive outcomes following pediatric stroke: a systematic review

Magdalena Mirkowski[1] · Amanda McIntyre[1] · Pavlina Faltynek[1] · Nicholas Sequeira[1] · Caitlin Cassidy[2,3] · Robert Teasell[1,2,3]

Received: 25 July 2018 / Revised: 31 January 2019 / Accepted: 14 February 2019 / Published online: 27 February 2019

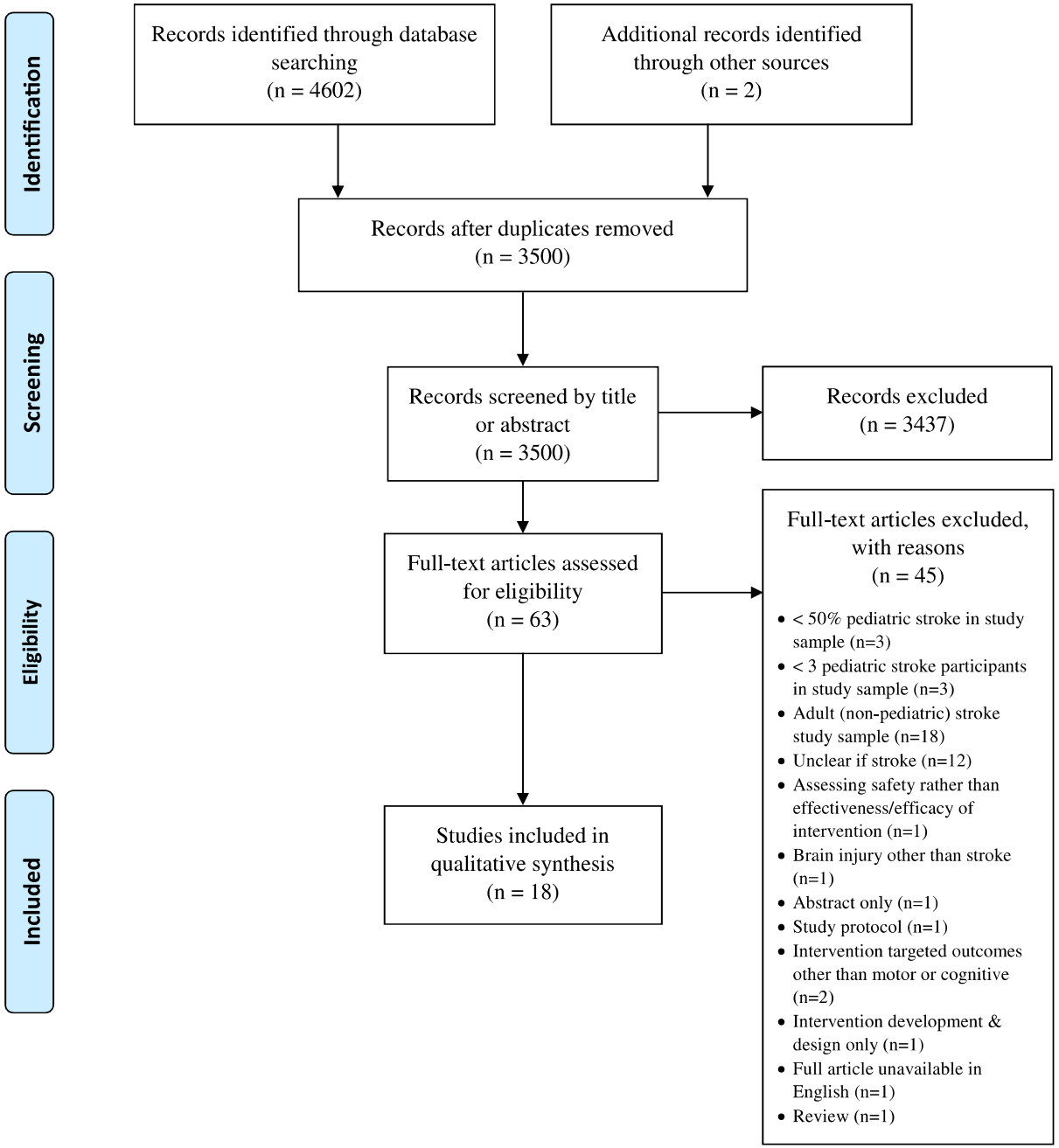
Abstract

The aim of this review was to evaluate the evidence for nonpharmacological rehabilitation interventions for motor and cognitive impairment following pediatric stroke. A literature search was conducted using multiple scientific databases. Studies were included if (1) the study population was > 50% pediatric (< 18 years) stroke, (2) a diagnosis of stroke was explicitly stated, (3) there were ≥ 3 pediatric stroke participants included in the study sample, and (4) motor or cognitive outcome measures were used to assess effect of treatment. Levels of evidence were assigned to each study to determine the strength of the evidence for each intervention. A total of 18 articles met inclusion criteria. Most studies ($N = 14$) examined rehabilitation of the upper limb, with constraint-induced movement therapy (CIMT) as the most common intervention. Overall, the evidence supports the use of CIMT, forced use therapy, repetitive transcranial magnetic stimulation, functional electrical stimulation, and robotics, but suggests no beneficial effect of transcranial direct current stimulation. Very few studies assessed interventions for the lower limb ($N = 1$) or cognitive impairment ($N = 3$).

Conclusion: Effective rehabilitation approaches are important for optimizing outcomes in children who have had a stroke. Although the number of published clinical trials has increased in recent years, little evidence-based guidance exists for this clinical population.

What is Known:
- *Pediatric stroke is a significant cause of disability in children that is often associated with long-term motor and cognitive sequelae.*
- *There is a need to establish a knowledge base regarding available evidence-based rehabilitation therapies for this clinical population.*

What is New:
- *Most studies examining interventions for motor function focus on upper limb rehabilitation, whereas few studies have investigated interventions for improving lower limb or cognitive impairment.*
- *An important gap exists regarding evidence-based rehabilitative treatment approaches for pediatric stroke.*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Unclear if stroke (n=12)
Assessing safety rather than effectiveness/efficacy of intervention (n=1)
Brain injury other than stroke (n=1)
Abstract only (n=1)
Study protocol (n=1)
Intervention targeted outcomes other than motor or cognitive (n=2)
Intervention development & design only (n=1)
Full article unavailable in English (n=1)
Review (n=1)
Studies included in qualitative synthesis (n = 18)

Motor Studies

- 15 studies – pooled sample size of about 200 participants
- 14 focused on upper extremity motor impairment
- 1 targeted at lower extremity motor impairment
- 7 studies were Randomized Controlled Trials
  - 2 were fair in methodological quality
  - 4 were good
  - 1 was excellent
- 2 were secondary analyses in follow up from RCTs
  - Quality of fair and good
- 6 studies were pre-post studies

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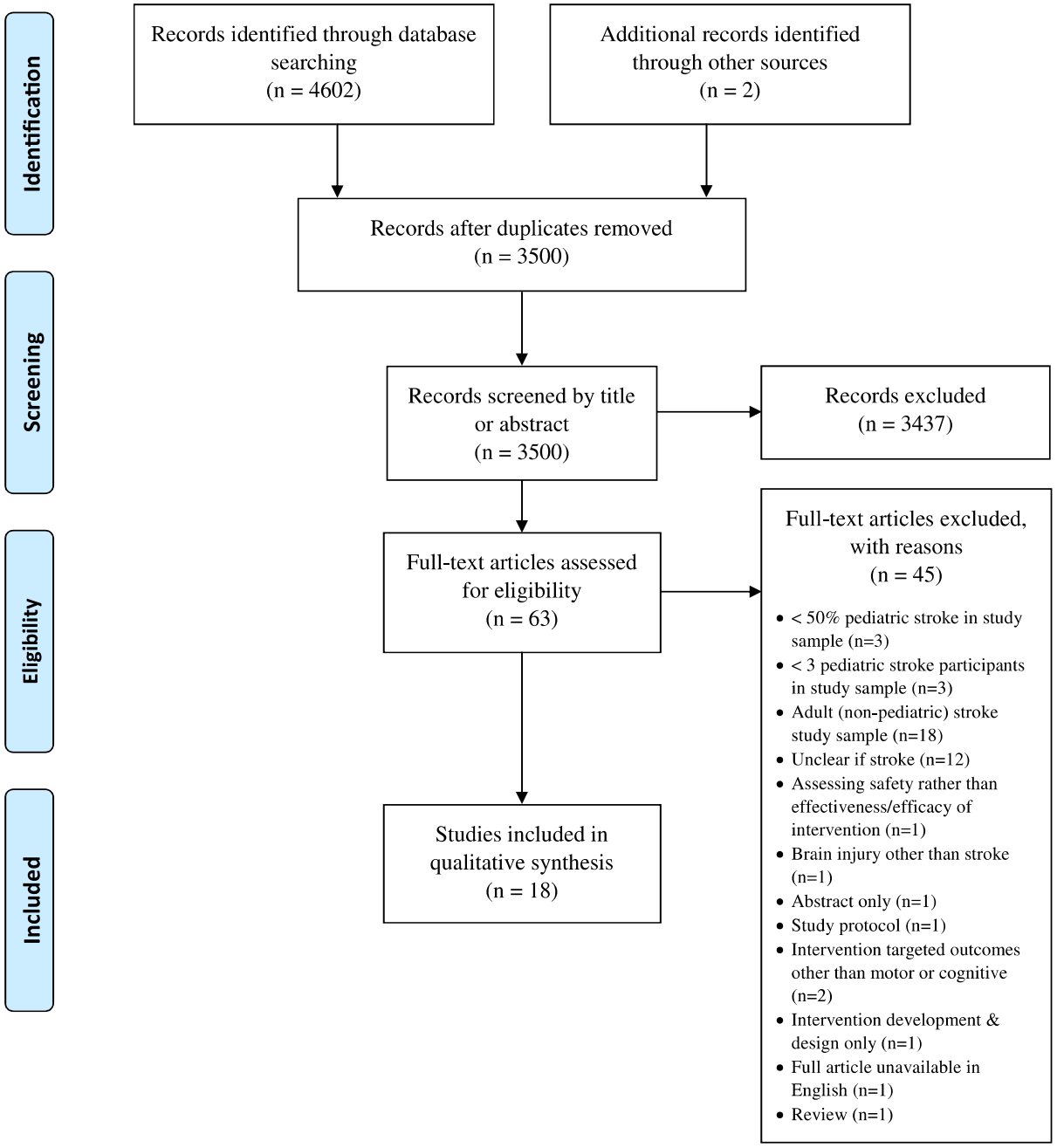
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  - 1 was excellent
- 2 were secondary analyses in follow up from RCTs
  - Quality of fair and good
- 6 studies were pre-post studies

Motor Studies - CIMT

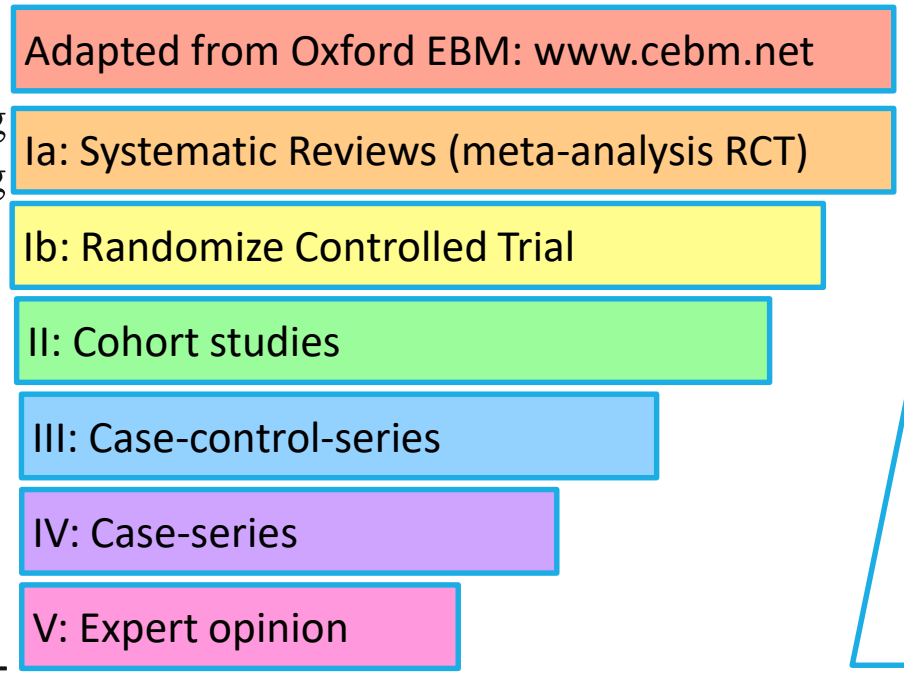
- Constrain-induced movement therapy, forced use therapy
- 6 studies, 3 RCTs

Levels of Evidence:

There is level 1b evidence that CIMT in combination with motor learning therapy may improve upper limb function compared to motor learning therapy alone in children with hemiparesis following pediatric stroke.

There is level 2 evidence that CIMT improves upper limb function compared to usual care in children with hemiparesis following pediatric stroke.

There is level 2 evidence that forced use therapy improves upper limb function compared to no intervention in children with hemiparesis following pediatric stroke.



Motor Studies – Walking training

- 1 pre-post study
  - Effect of exercise training program on walking ability
  - 5 children
  - Improvements in Gross Motor Function Measure

Levels of Evidence:

There is level 4 evidence that walking training may improve walking ability in children with hemiparesis following pediatric stroke.

Motor Studies – Transcranial direct current stimulation

- 1 RCT compared tDCS to sham
- 1 RCT with tDCS and motor learning therapy to sham with motor learning therapy
  - Included CIMT and bimanual training
  - Significant improvement in AHA scores, no difference between groups

---

Levels of Evidence:

There is level 1b evidence that tDCS does not improve upper limb function compared to sham tDCS in children with hemiparesis following pediatric stroke.

There is level 1b evidence that tDCS in combination with motor learning therapy does not improve upper limb function compared to sham tDCS in combination with motor learning therapy in children with hemiparetic cerebral palsy following pediatric stroke.

Motor Studies – Repetitive transcranial direct magnetic stimulation

- 1 RCT compared rTMS to sham over 8 days
- 1 RCT compairing rTMS with motor learning vs motor learning and CIMT vs sham and motor learning
- 1 with rTMS with CIMT vs sham with CIMT

Levels of Evidence:

There is level 1b evidence that rTMS may improve upper limb function compared to sham rTMS in children with hand weakness following pediatric stroke.

There is level 1b evidence that rTMS in combination with either motor learning therapy or both CIMT and motor learning therapy may improve upper limb function compared to sham rTMS in combination with motor learning therapy without CIMT in children with hemiparesis following pediatric stroke.

There is level 1b evidence that rTMS in combination with CIMT may improve upper limb function compared to sham rTMS in combination with CIMT in children with hemiparesis following pediatric stroke.

Motor Studies

- Functional electrical stimulation
  - 1 pre post with 4 children

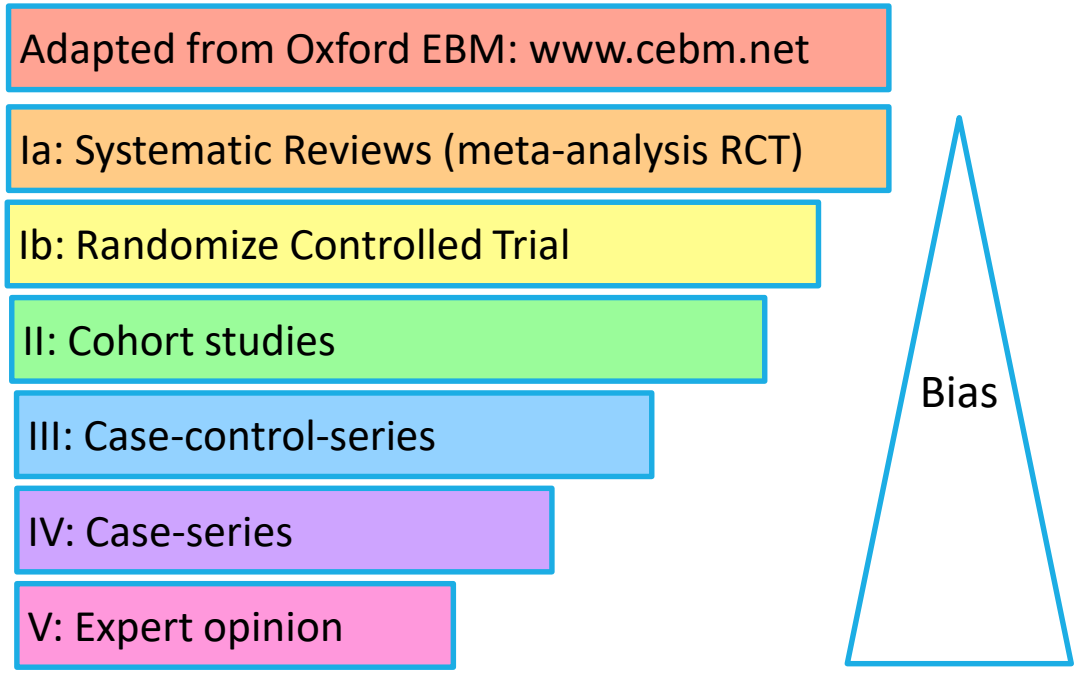
Levels of Evidence:

There is level 4 evidence that FES may improve upper limb function in children with hemiplegia following pediatric stroke.

- Robotics
- 1 pre post with 12 children

Levels of Evidence:

There is level 4 evidence that robotics may improve upper limb function in children with hemiplegia and spasticity following pediatric stroke.



Cognitive Studies

- 3 studies – pooled sample size of about 22 participants
- 14 focused on upper extremity motor impairment
- 1 targeted at lower extremity motor impairment
- 1 study was a Randomized Controlled Trials
  - Poor quaility
- 1 was a prospective controlled trial
  - Quality of fair and good
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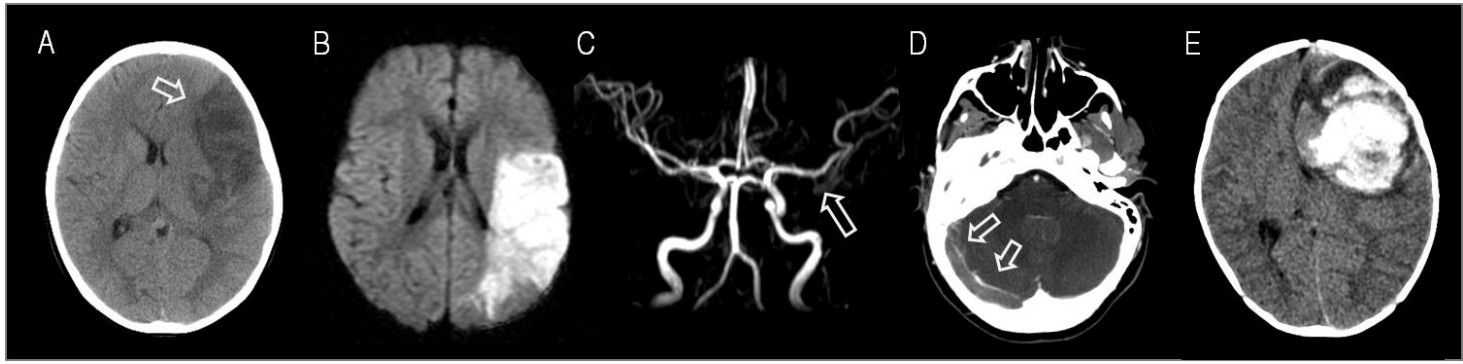

Cognitive Studies

- 1 RCT and 1 Prospective controlled trial
  - Memory training with academic tutoring to tutoring alone
  - 1 pre-post study examined effect of computerized working memory training

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Levels of Evidence:

There is level 2 evidence that memory training in combination with academic tutoring may improve memory compared to academic tutoring alone in children following pediatric stroke.

There is level 4 evidence that computerized memory training may improve working memory but not attention in children following pediatric stroke.

Available Literature

- Systemic Reviews
- Randomized Controlled Trials
- Cohort Studies
- Case Control Studies
- Case Series and Reports
- Editorials/Expert opinions

Considerations

- Bias
- Randomized Controlled Trials
  - Question
  - Power
  - Blinding
- Reviews
  - Quality studies being reviewed
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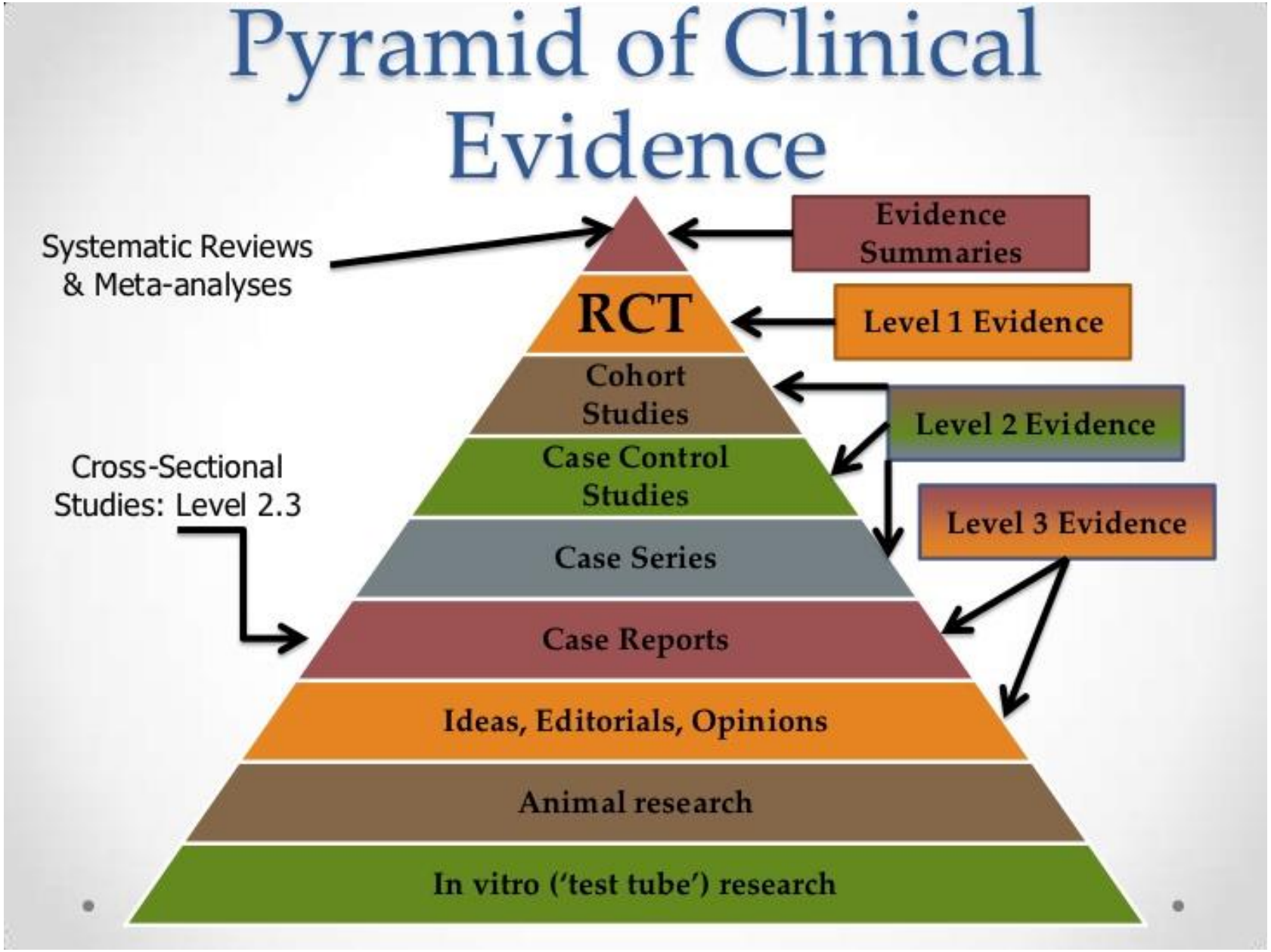
Pyramid of Clinical Evidence
Systematic Reviews & Meta-analyses
Cross-Sectional Studies: Level 2.3
Evidence Summaries
Level 1 Evidence
Level 2 Evidence
Level 3 Evidence
RCT
Cohort Studies
Case Control Studies
Case Series
Case Reports
Ideas, Editorials, Opinions
Animal research
In vitro ('test tube') research

Evaluating papers Checklist hand out

- Determining what a papers is about
  - Why was the study performed?
  - What type of study?
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Table 1 Modified Sackett scale

Level	Description
1a	More than one RCT (PEDro score ≥ 6)
1b	One RCT (PEDro score ≥ 6)
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PEDro Physiotherapy evidence database, *RCT* randomized controlled trial

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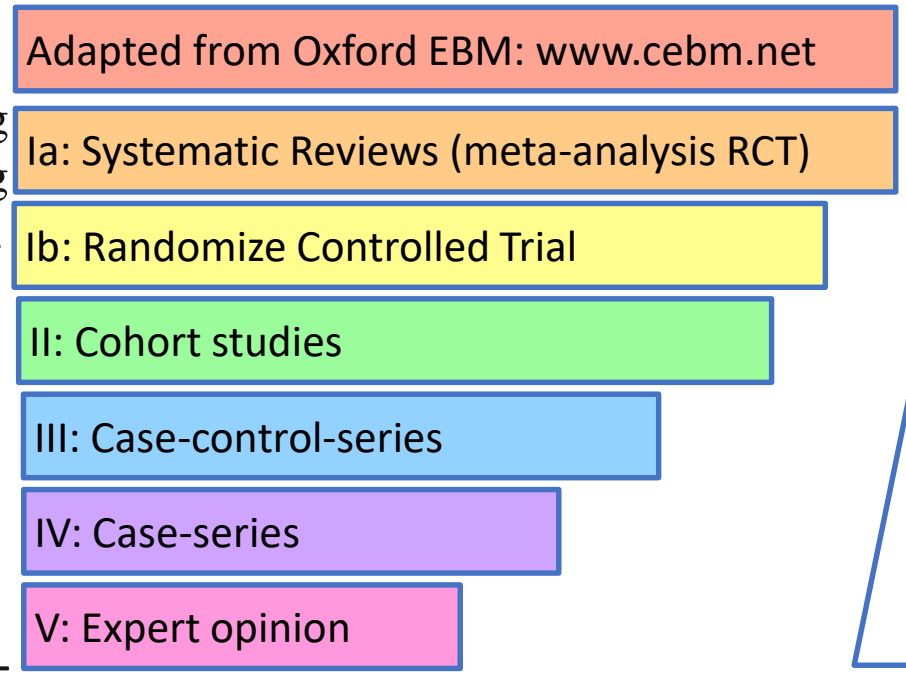

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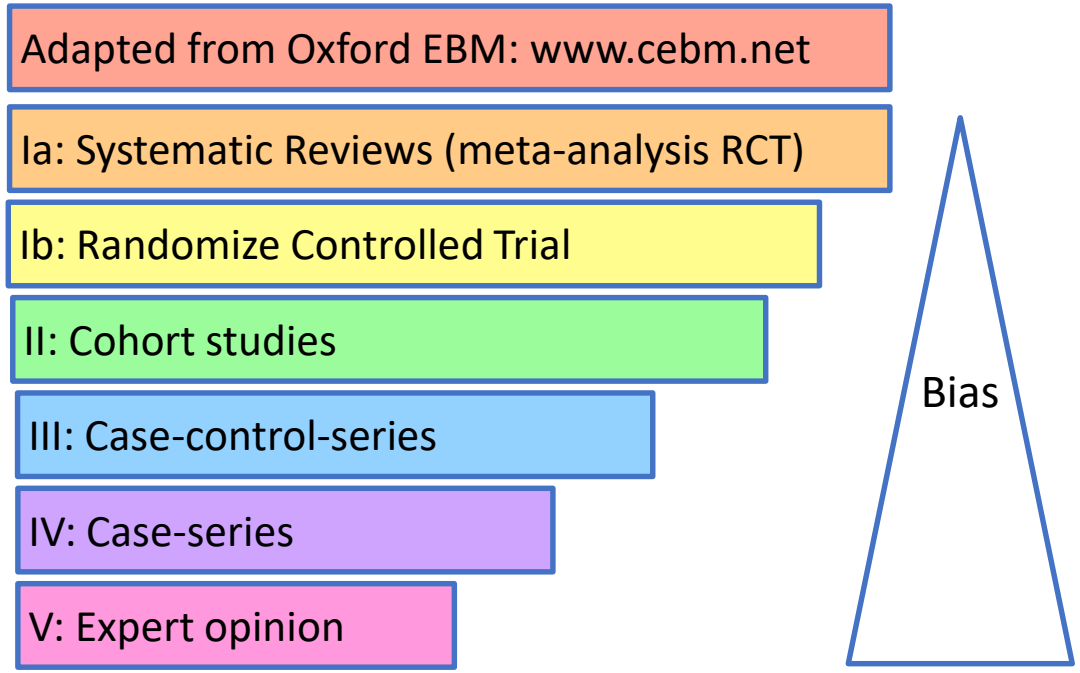

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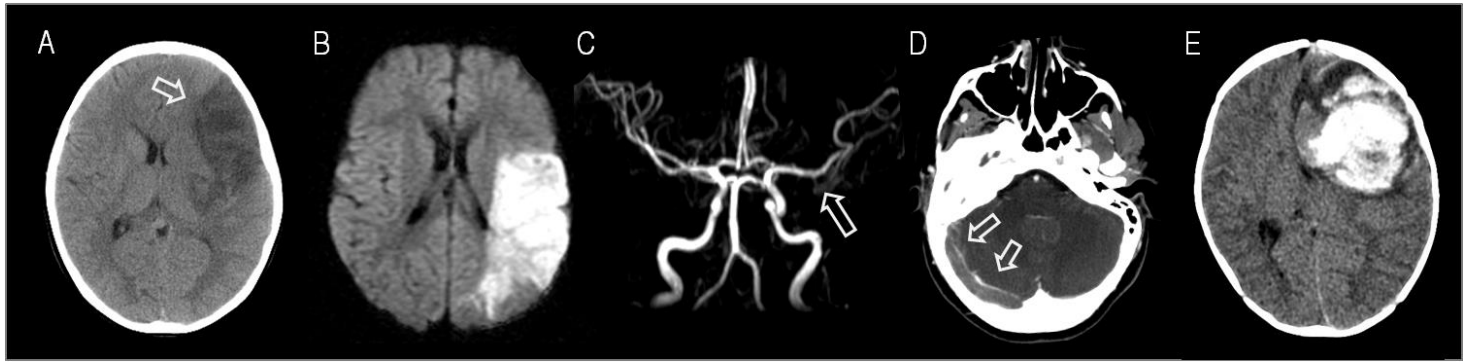

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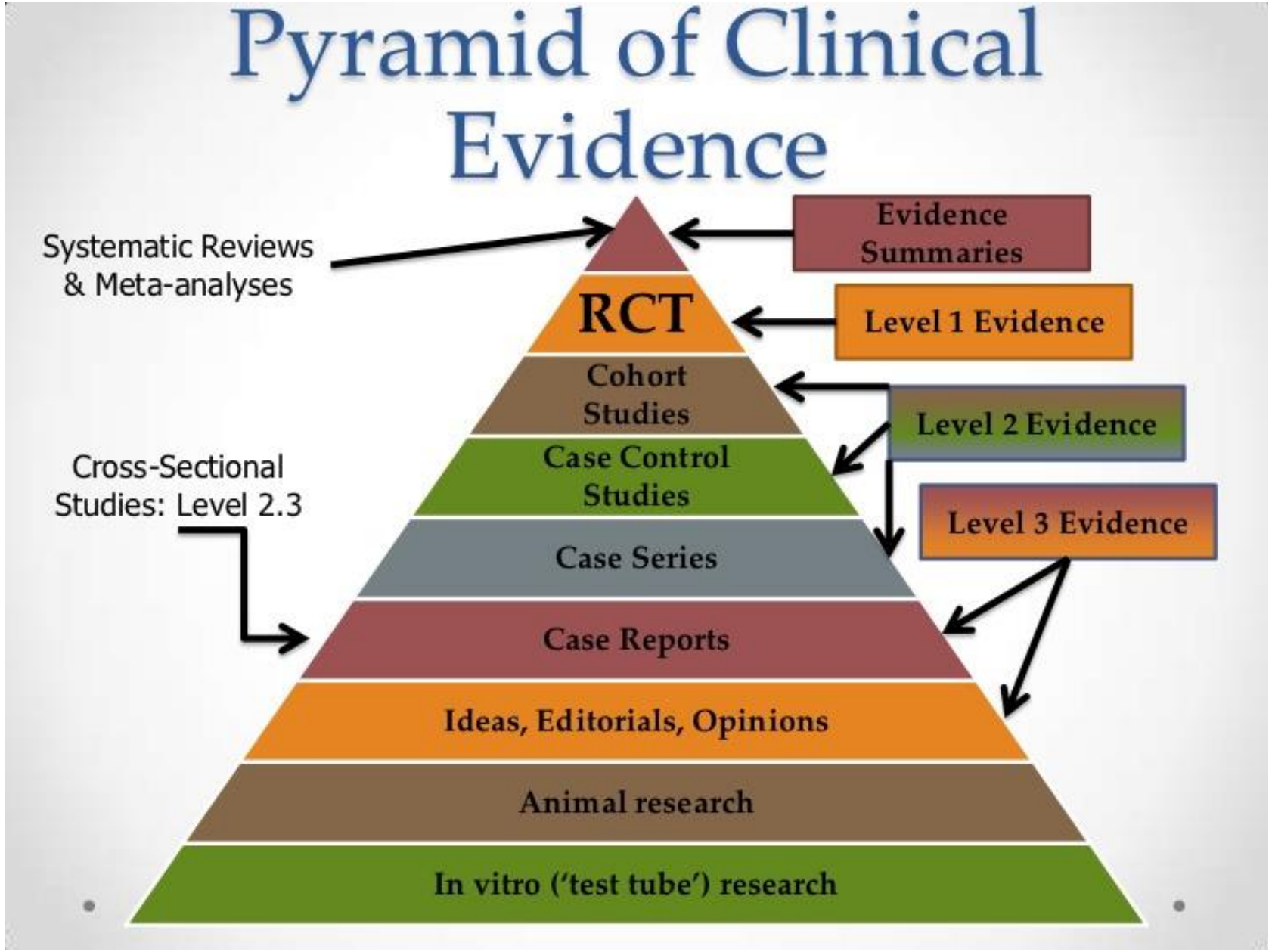

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