A close-up photograph of a hand holding a pencil, poised to write on a document. The document features a grid of small circles, some of which are filled with dark ink. The background is softly blurred, showing what appears to be a person in a white lab coat, suggesting a clinical or research setting.

Neonatal Sleep Assessment Optimizing Sleep As A Trauma-Responsive Approach

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&
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- Dr. Thomas Alderliesten
- Dr. Agnes van den Hoogen
- Xiaowan Wang
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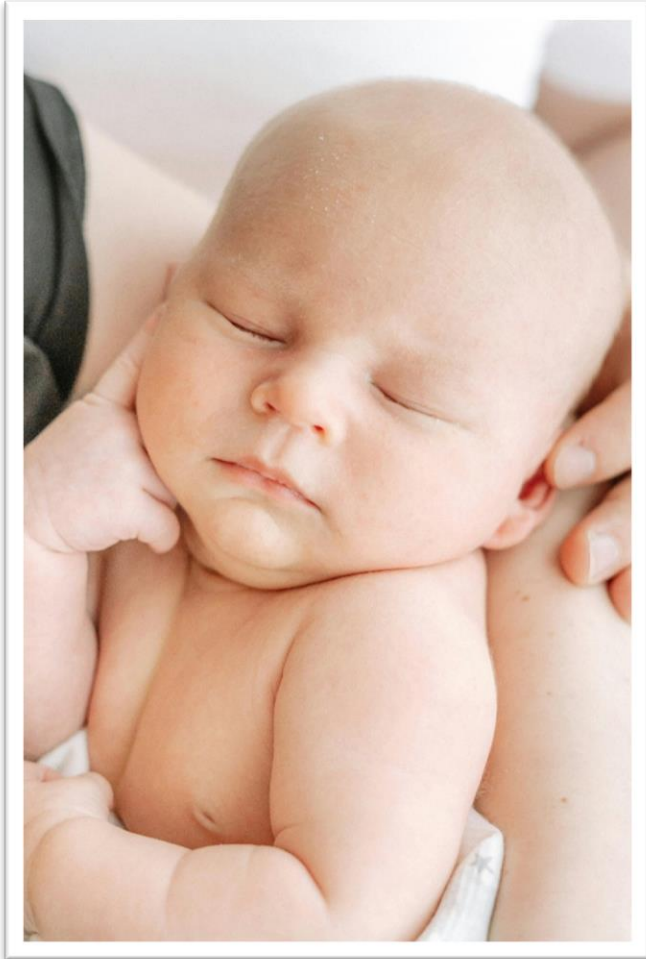

Especially the
babies & parents

The 
Netherlands



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Disclosures



We have no relevant financial disclosures.

Re: non-financial disclosures

Dr. de Groot is the primary author of the BeSSPI Preterm Sleep Assessment

Learning Objectives:

01

Describe the importance of sleep for newborn brain development and how sleep protection can be used as a neuroprotective and trauma-responsive strategy when caring for preterm and medically fragile infants.

02

Identify distinct infant behaviors used to differentiate between active sleep, quiet sleep, and awake states of newborn and preterm infants.

03

Identify at least three recommended sleep strategies that are evidence-based, expert-approved, and endorsed by parents as effective for sleep optimization before and after discharge from the neonatal intensive care unit (NICU).



Let's Begin with a Poll:

When experiencing significant stress, what do you do to become regulated and return to baseline? (word cloud)



When experiencing significant stress, what do you do to become regulated and return to baseline?

Nobody has responded yet.

Hang tight! Responses are coming in.

Start the presentation to see live content. For screen share software, share the entire screen. Get help at pollev.com/app

Polling Results



Infant Medical Trauma in the Neonatal Intensive Care Unit (IMTN)

Neonatal trauma is unique:

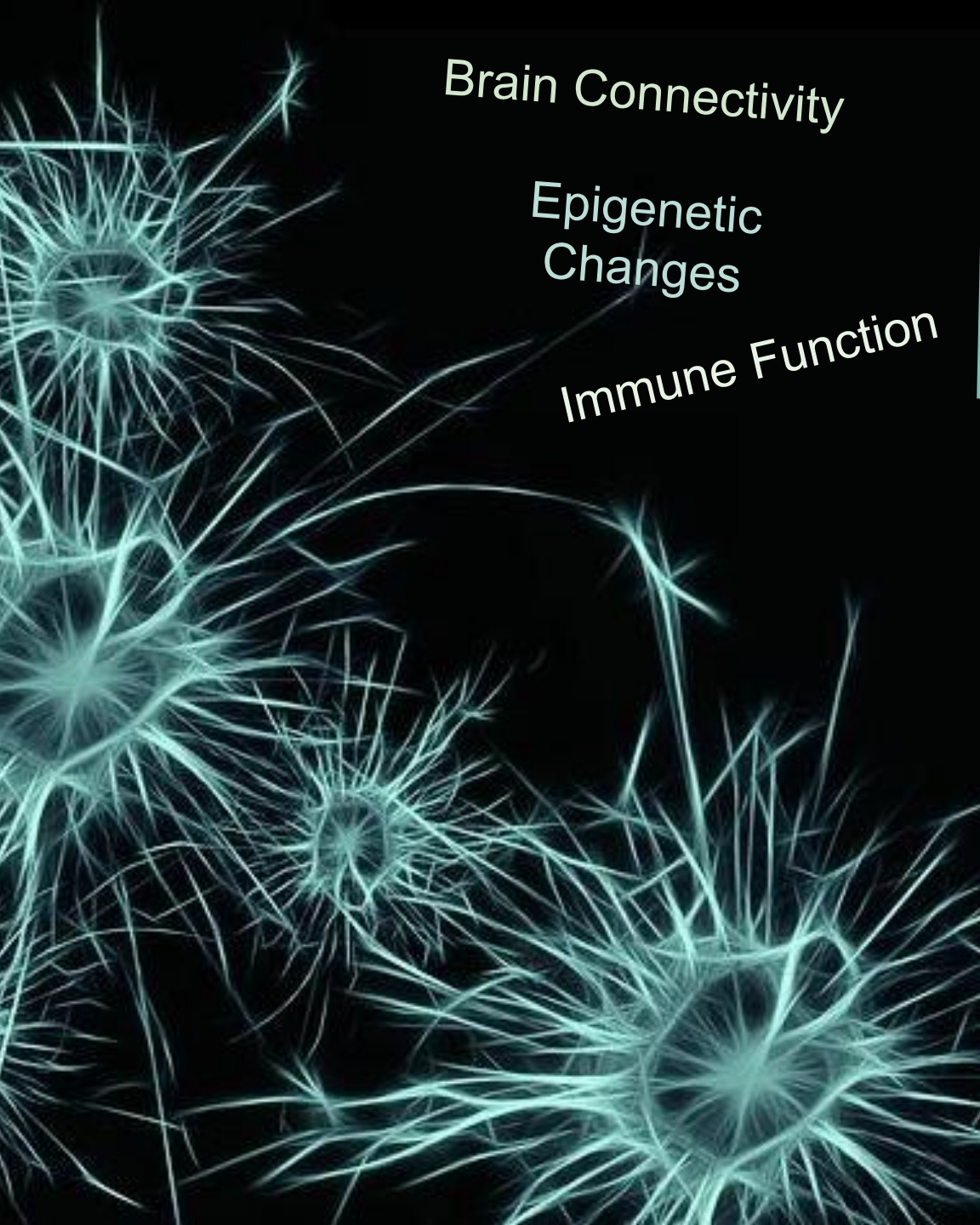
It occurs at a highly vulnerable, rapid stage of development.

The score-keeping phenomenon:

Responses of distress and tactile hypersensitivities are painful experiences without pain medication

Neonatal staff often avoid the term 'trauma' to describe aspects of their care because it conflicts with their self perception as a healer

(D'Agata et al., 2016)



Brain Connectivity

Epigenetic
Changes

Immune Function

Adverse Effects of Trauma: The Neuroscience

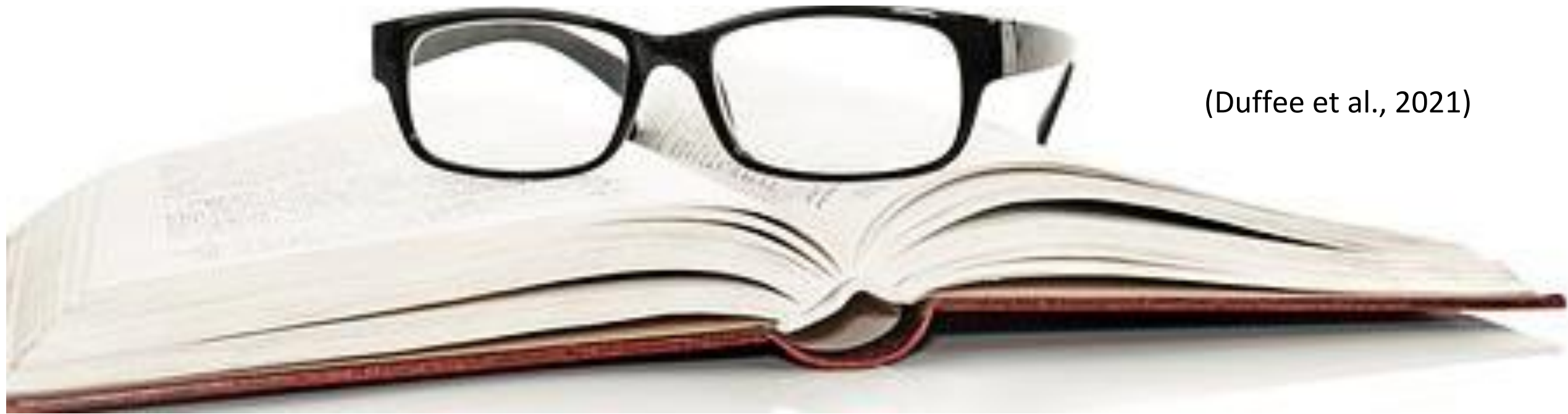
- Cortisol acts on rapidly developing brain structures during early development
- Methylation patterns are impacted by cortisol which in turn impacts gene expression
- Alterations of the immune system occur in response to constant threat

(Forkey et al., 2021)

What Can We Do To Be More Trauma-Responsive Caregivers?

“Trauma-informed care occurs when all parties involved **assess, recognize and respond** to the effects of traumatic stress on children, caregivers, and healthcare providers.”

(Duffee et al., 2021)





Can optimizing sleep help mitigate the adverse effects of neonatal trauma?

It makes sense but where is the evidence?



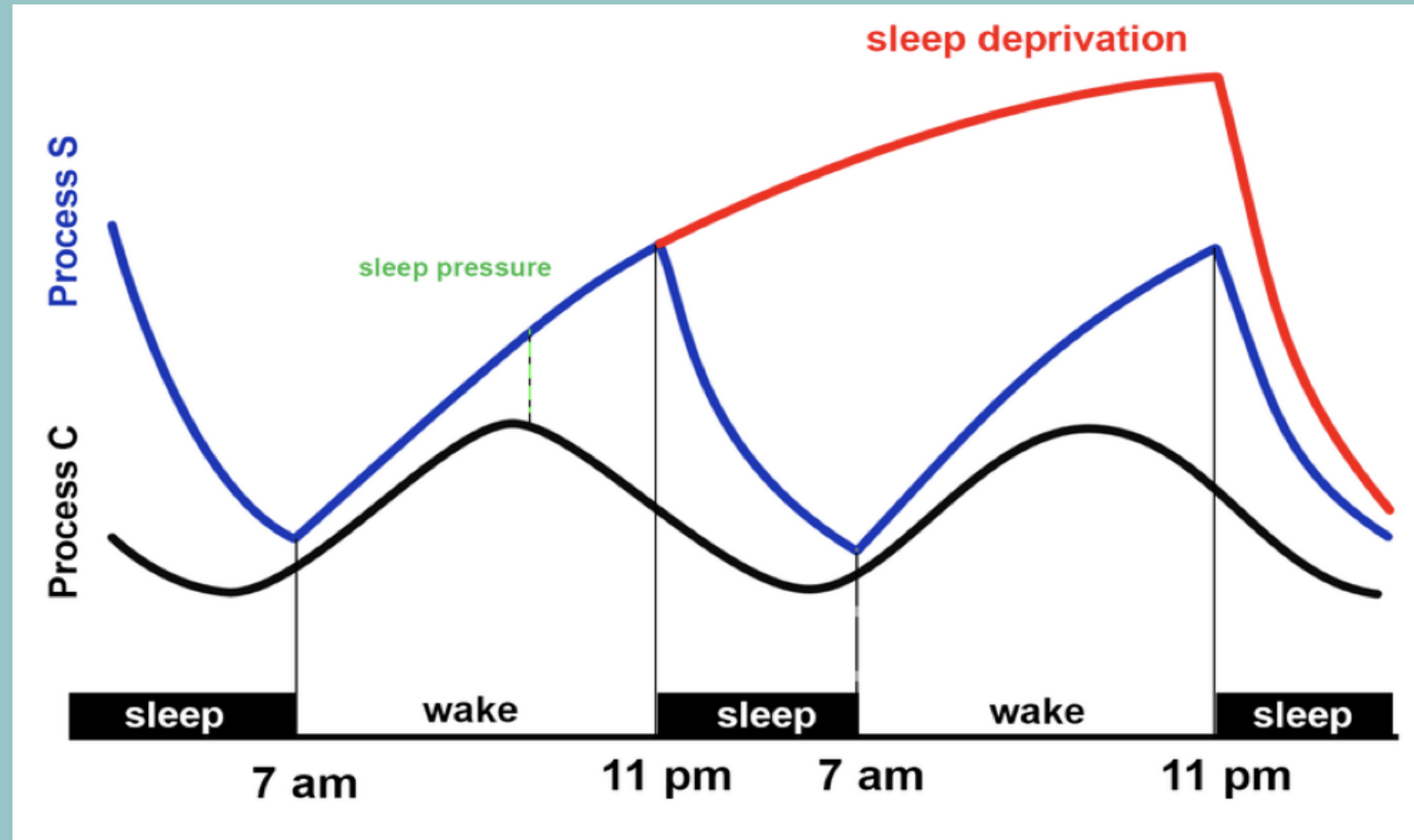
The Fundamentals of Sleep



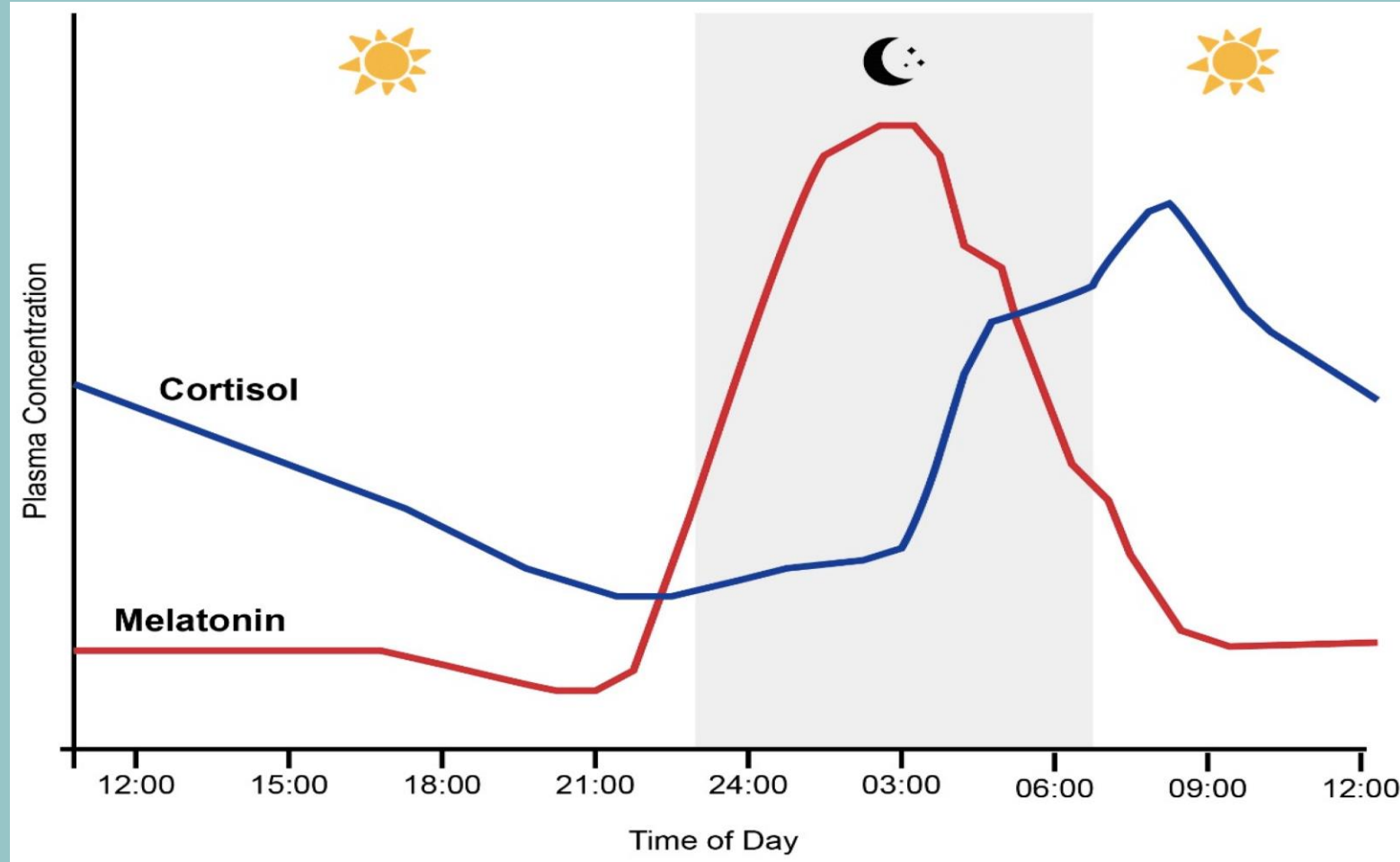
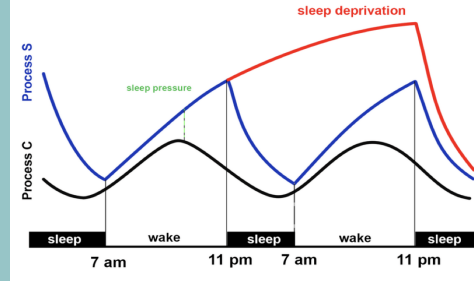
Biological Mechanisms of Sleep

Process S:
Sleep Homeostasis

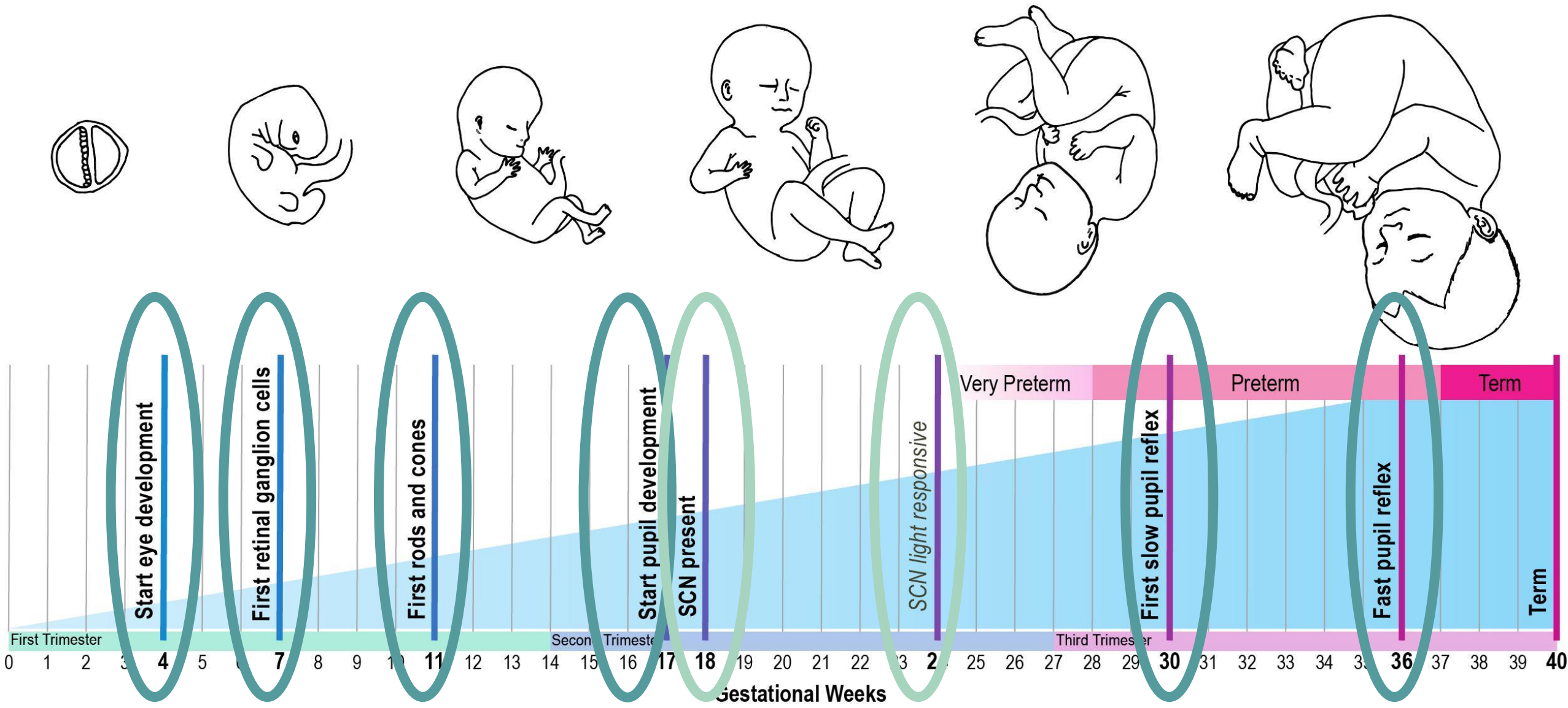
Process C:
Circadian Rhythms



Circadian Rhythms in Adults



Development of the Circadian Rhythm



Circadian Rhythms In Preterm Infants



Circadian rhythms are the body's internal clock — 24-hour cycles



Consideration #1 for Preterm Infants

There are no endogenous circadian rhythm in preterm infants

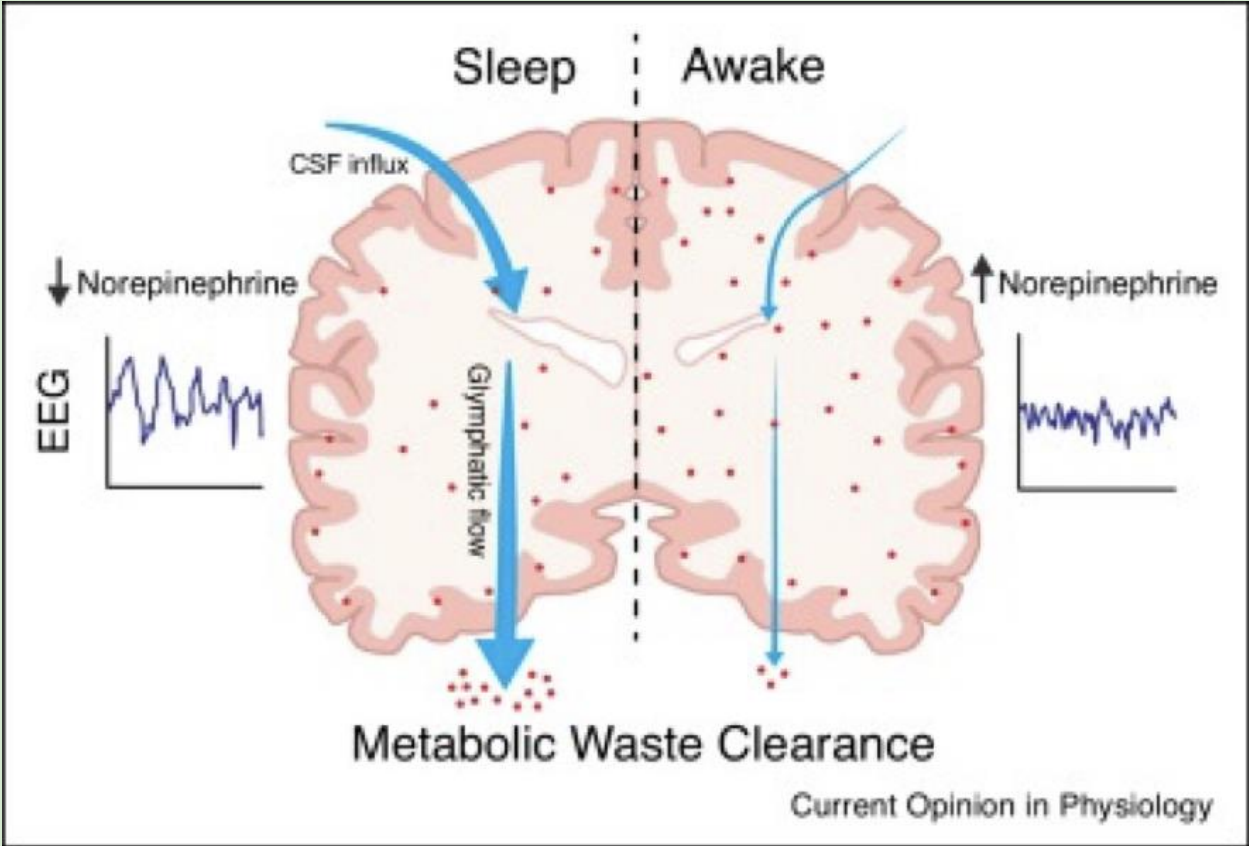
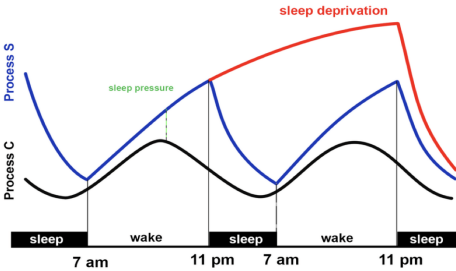
Consideration #2 for Preterm Infants

Circadian rhythm entrainment supports neurodevelopment in extrauterine life

Consideration #3 for Preterm Infants

Light/dark cycles in the NICU are important!

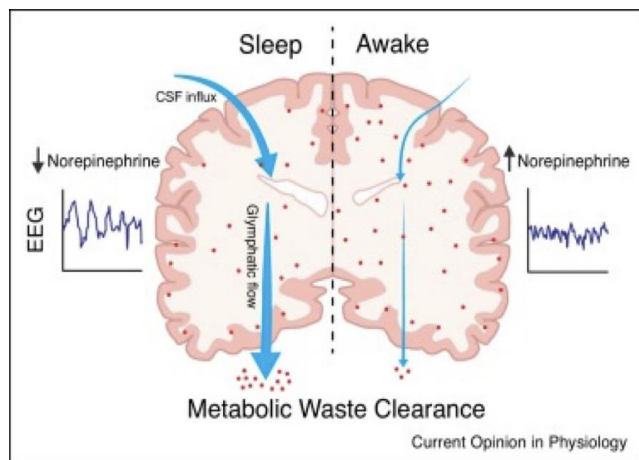
Sleep homeostasis



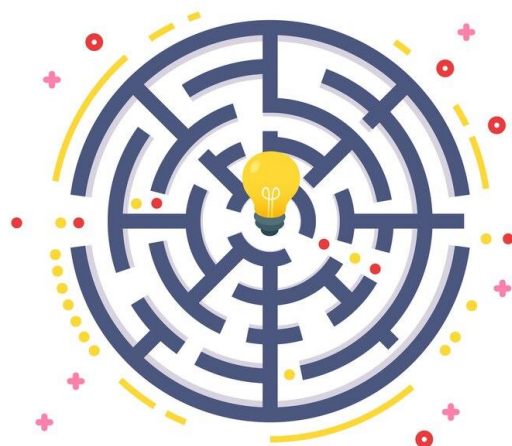
**During Sleep, your
‘Glymphatic System’
clears metabolic waste**

Hauglund, 2020

Other Important Functions of Sleep



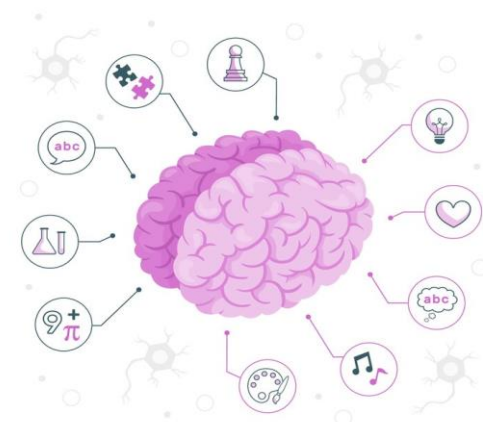
Cleansing
The brain
of waste



Pruning the
brain for
efficiency



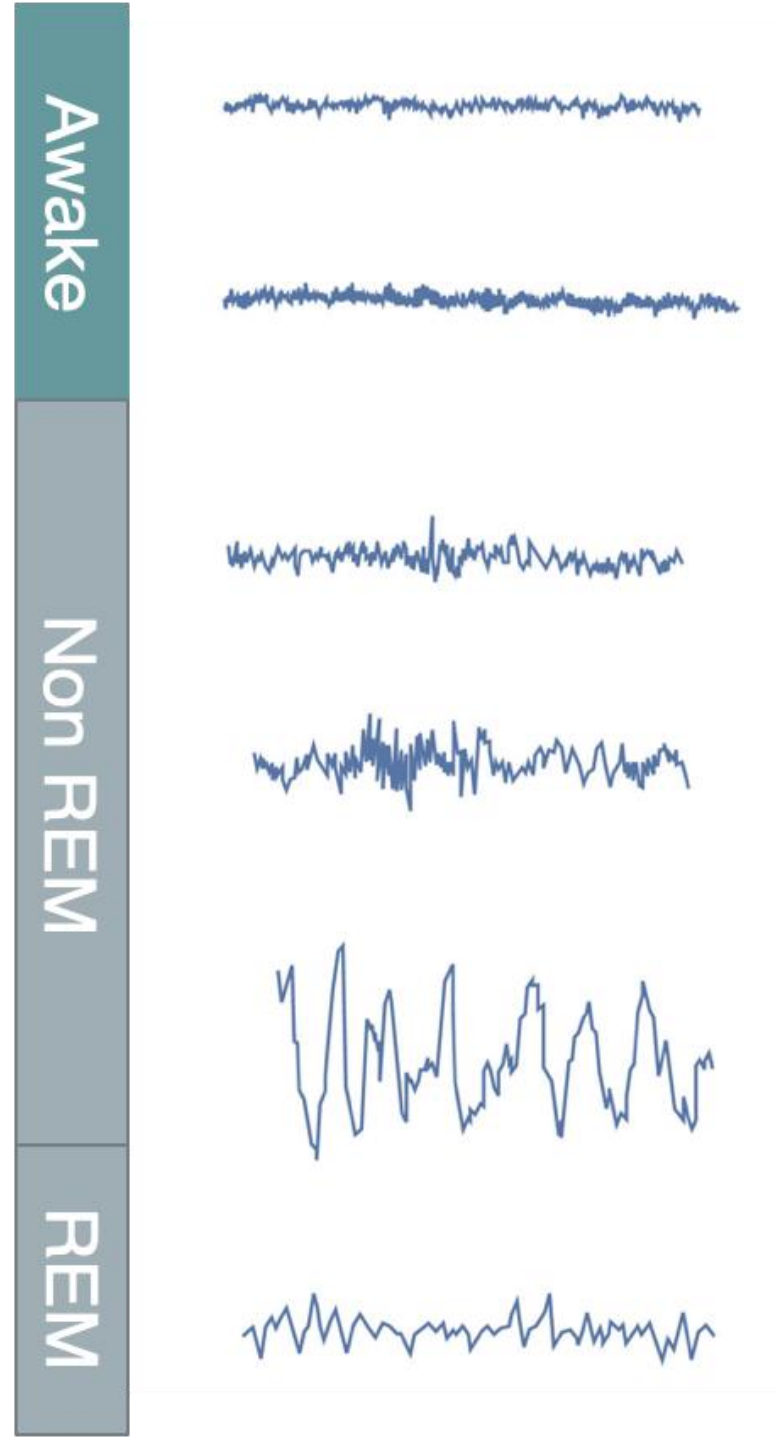
Supports
the immune
system



Forming and/or
reinforcing
brain connections

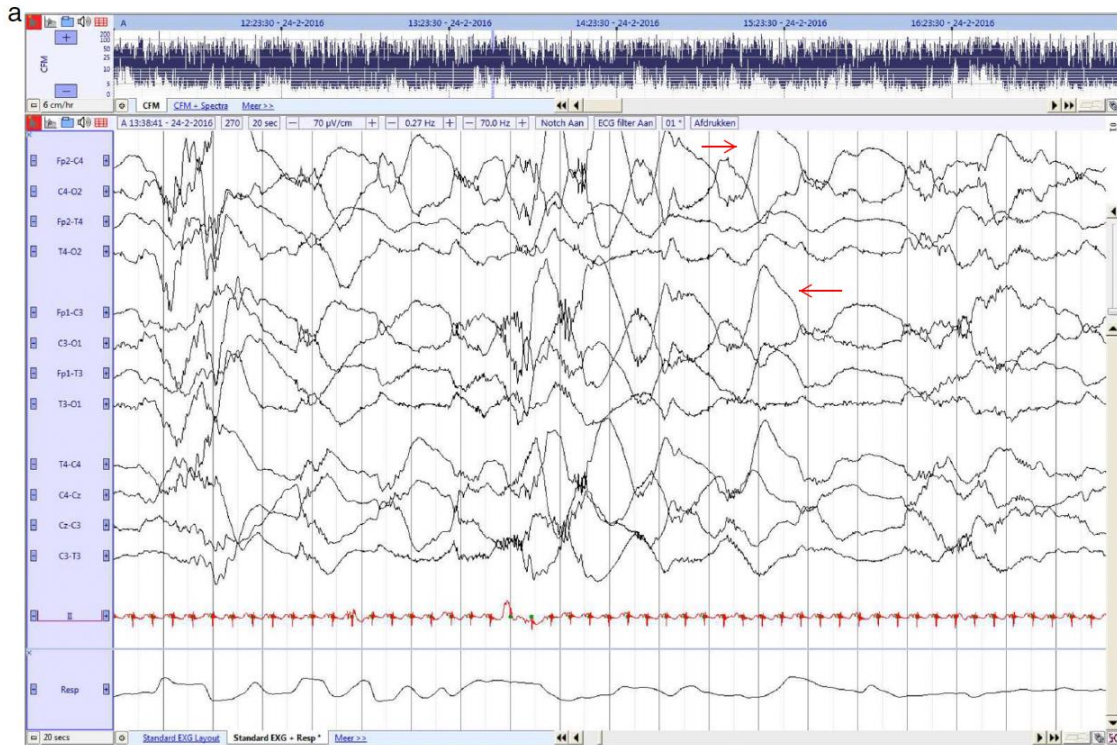


**What adult
does sleep
look like
on EEG?**

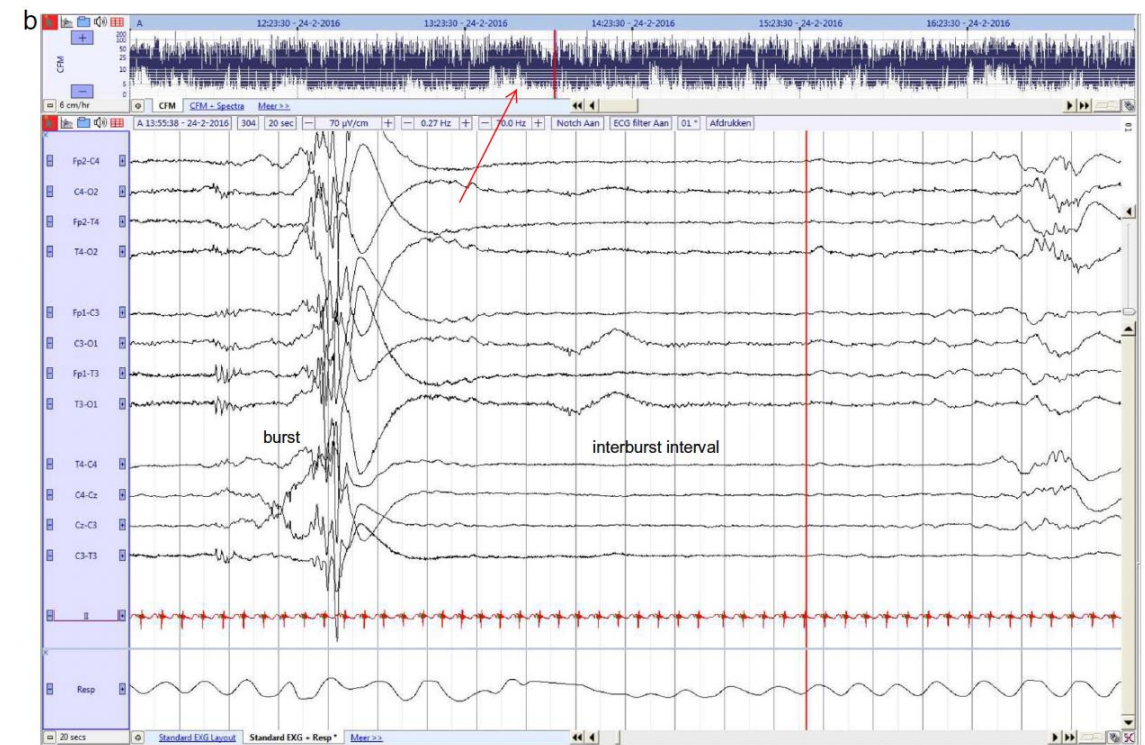


What preterm sleep look like on EEG:

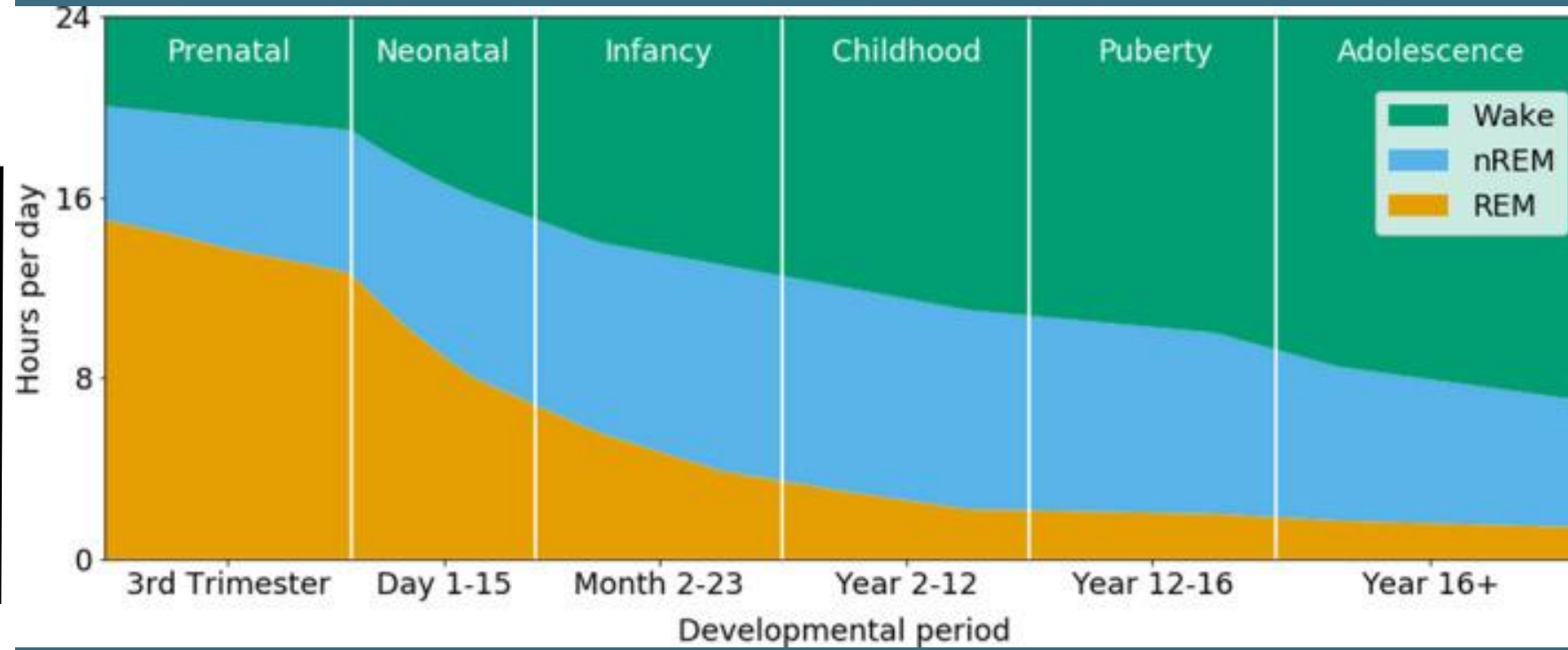
Active Sleep



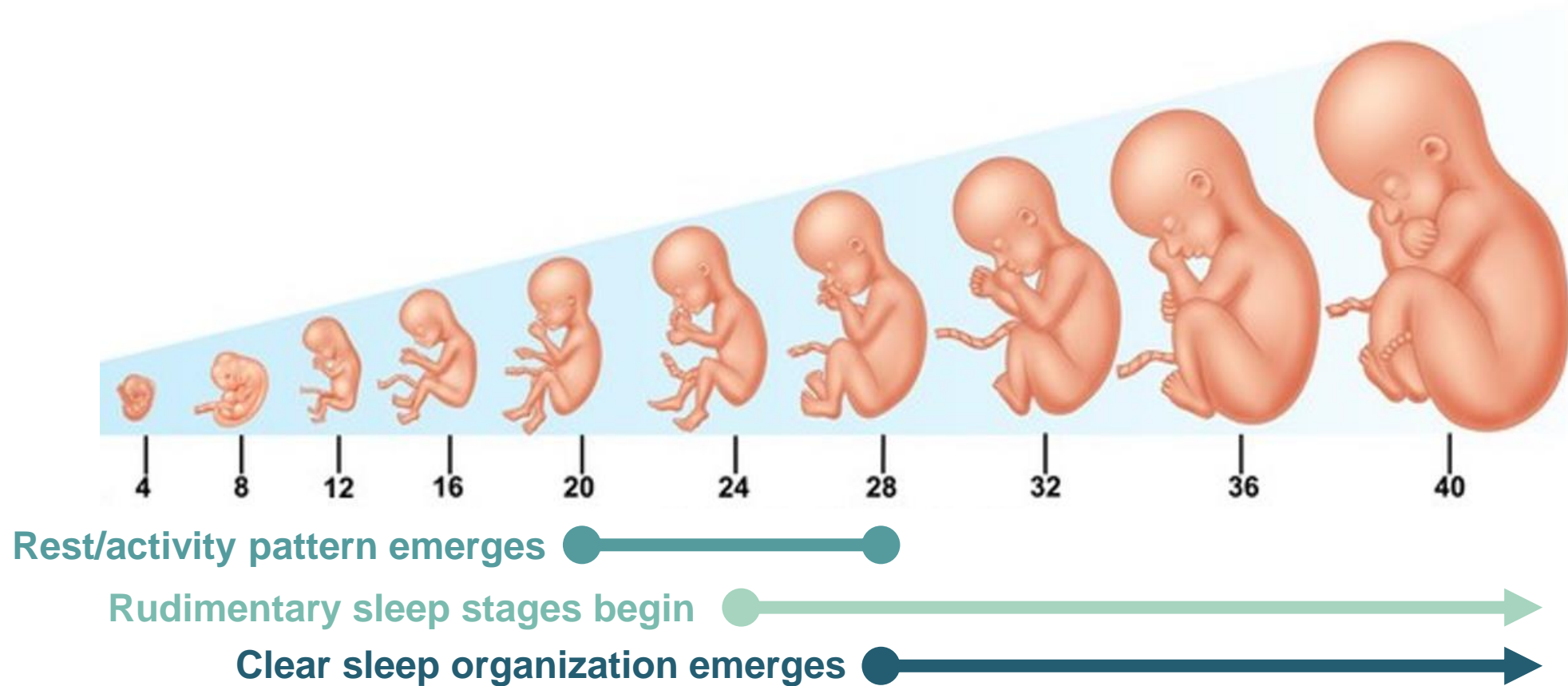
Quiet Sleep



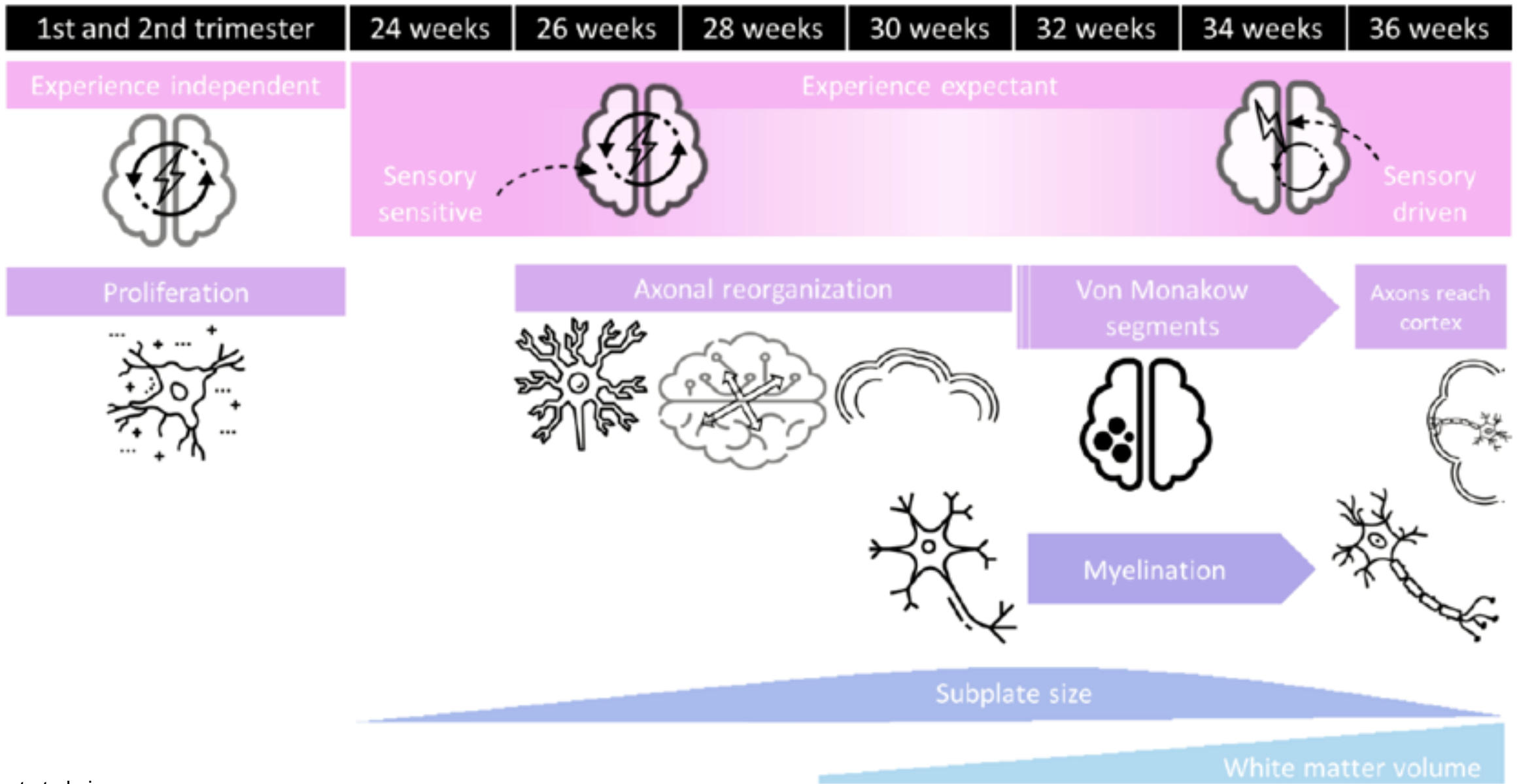
Developmental Sleep Progression



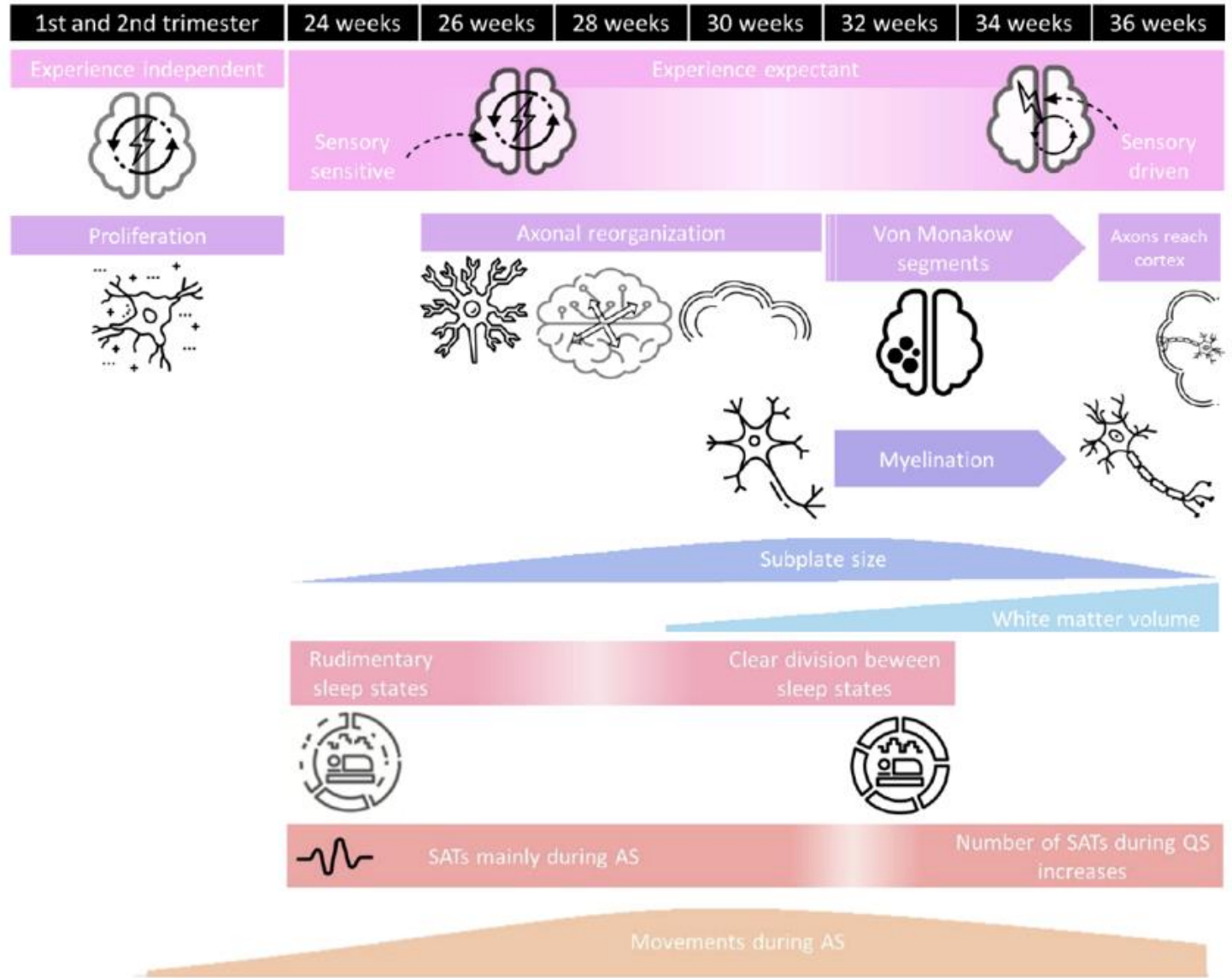
Emergence of sleep stages



Brain development and sleep architecture



Brain development and sleep architecture



Neurodevelopment

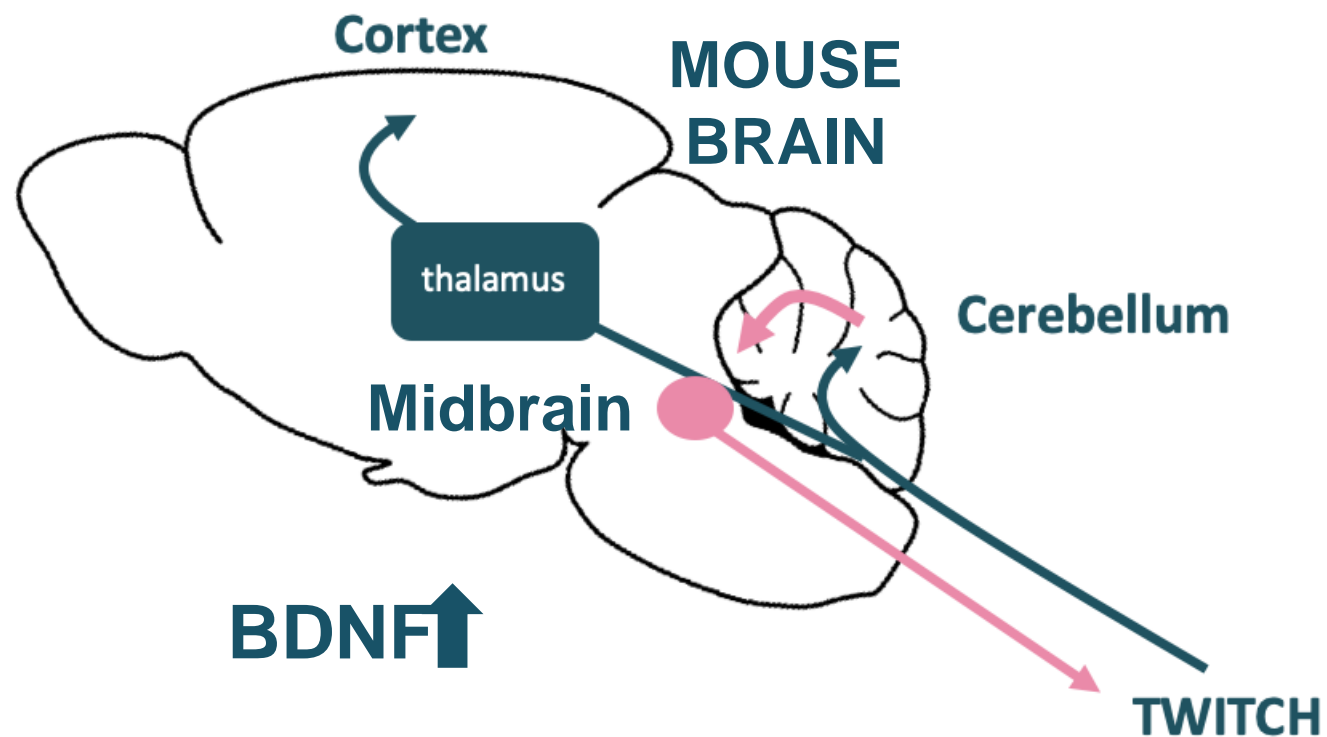
Sleep architecture

Sleep Animal studies



Video van Shutterstock

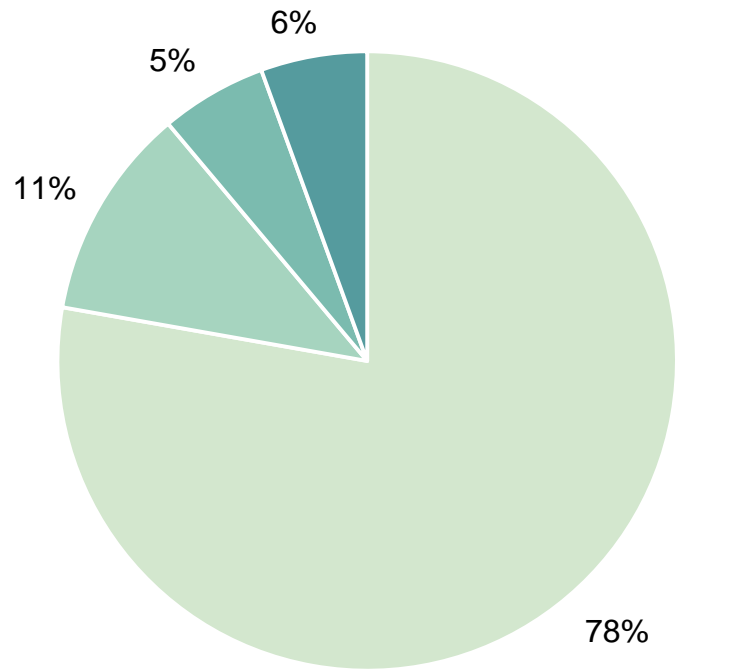
Active sleep and connectivity



Del Rio-Bermudez,
2015

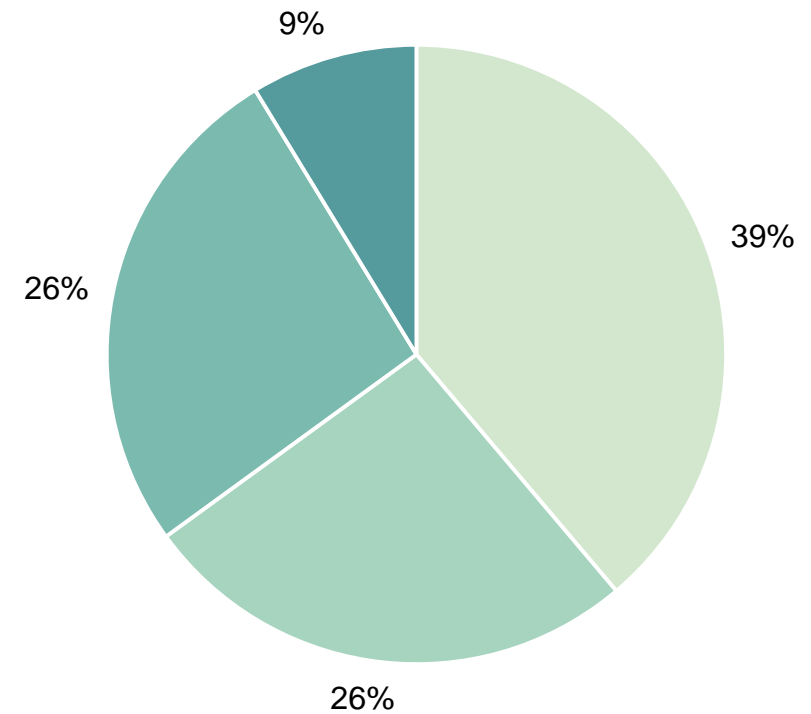
Sleeping in the NICU

Fetal sleep



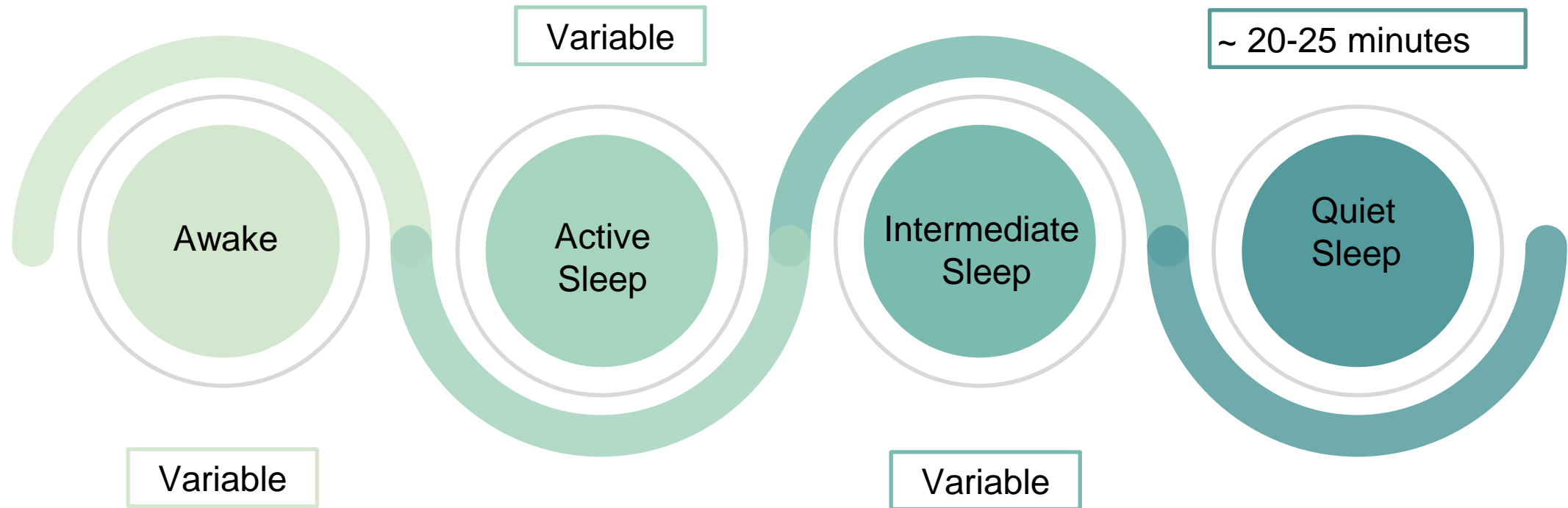
- Active sleep
- Quiet sleep
- Intermediate sleep
- Wake

Preterm sleep

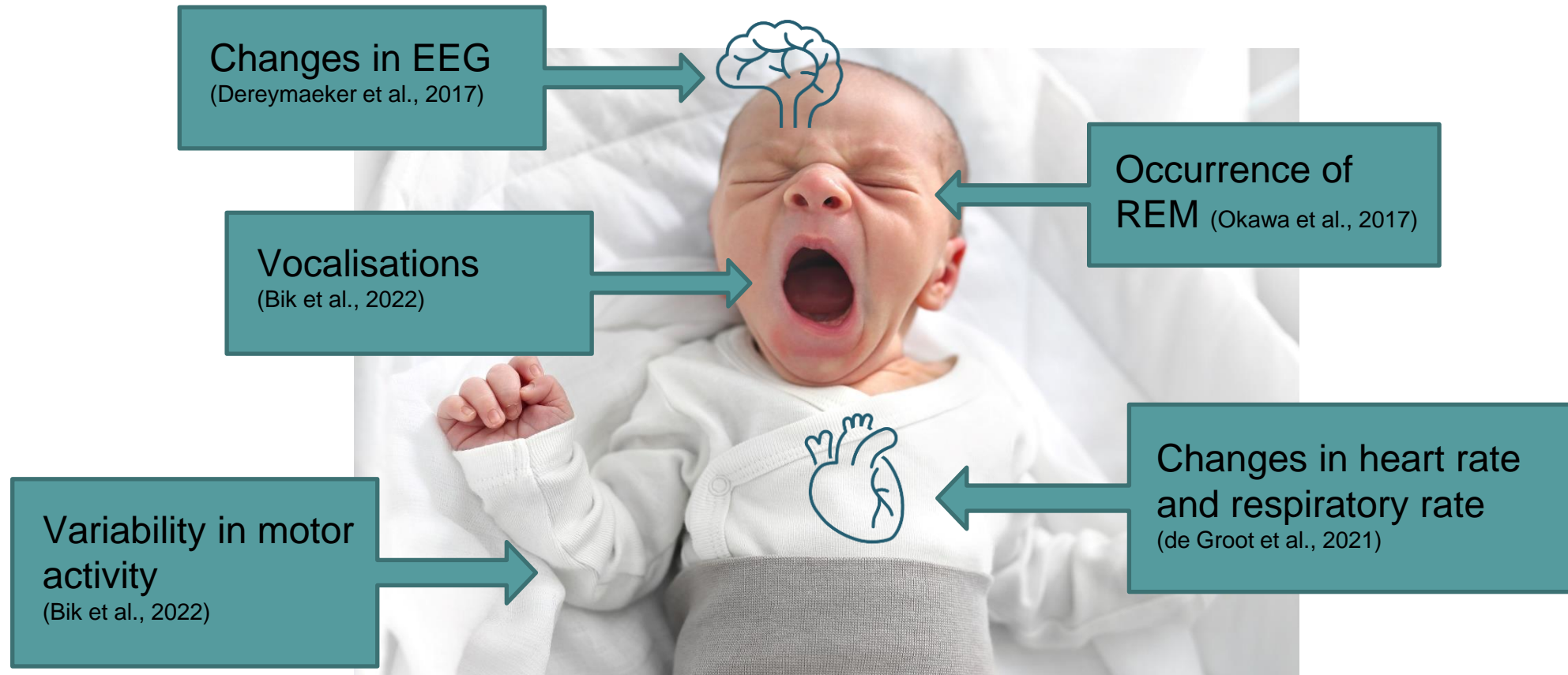


- Active sleep
- Quiet sleep
- Intermediate sleep
- Wake

The preterm sleep cycle



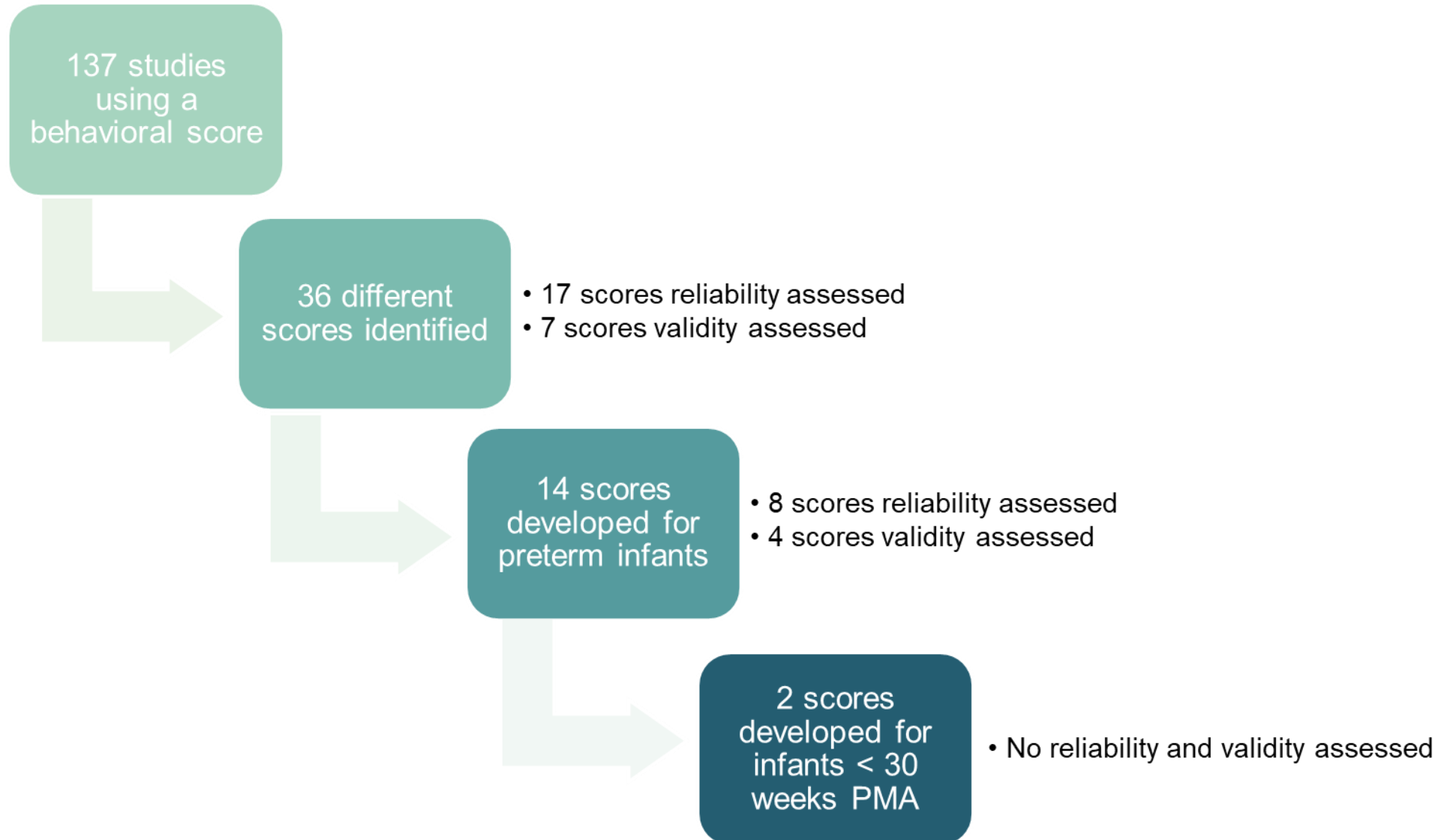
Sleep characteristics



Ways to measure preterm sleep



Exploring existing behavioral scores



Sleep Parameters in Observational Sleep Assessment

All characteristics are assessed 4 times per minute, using 15-second cycles.

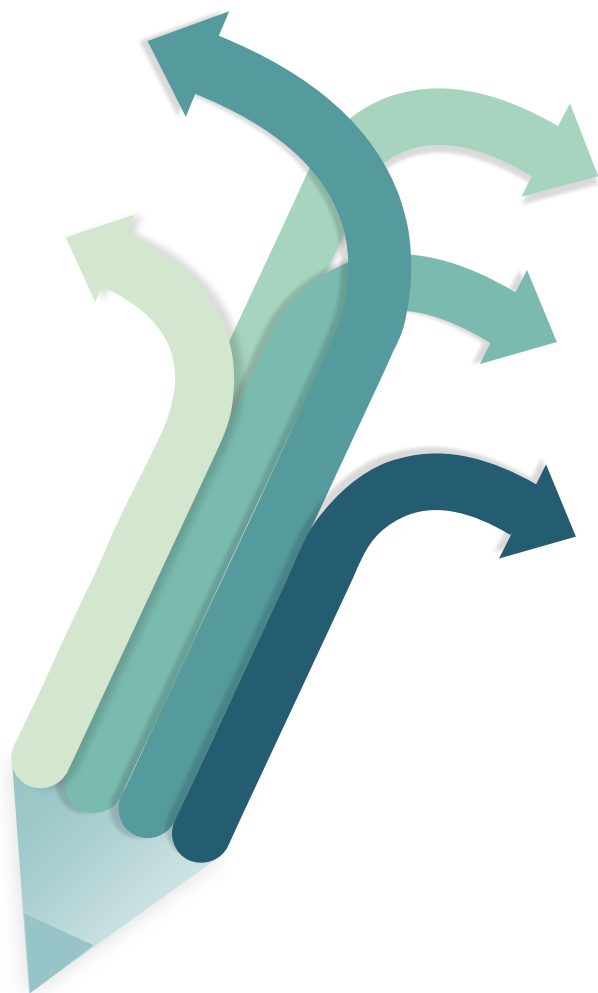


- ✓ Eye Movements
 - ✓ Body Movements
 - ✓ Facial Movements
 - ✓ Vocalizations
 - ✓ Breathing Rate
 - ✓ Heart Rate
-
- ✓ Activity level

69 Infants: 10.981 Minutes



New behavioral score is...



Unobtrusive

Widely usable

Validated

High reliability

Also for extremely preterm infants

Easy to learn and use

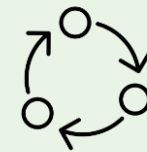
Original Article

Creating an optimal observational sleep stage classification system for very and extremely preterm infants

E.R. de Groot^a, A. Bik^{a,1}, C. Sam^{a,1}, X. Wang^a, R.A. Shellhaas^b, T. Austin^c,
M.L. Tataranno^a, M.J.N.L. Benders^a, A. van den Hoogen^{a,d}, J. Dudink^{a,e}



Based on 69 infants
(10.981 minutes)



Multiple cycles of
development

Training time = 3-5 hours

$\kappa = .80$

Let's take a closer look at how to apply this tool...



Quiet Sleep



Active Sleep



Awake

QUIET SLEEP



ACTIVE SLEEP #1



ACTIVE SLEEP #2



Audience Poll

**What stands
out as a
difference
between
active sleep
and quiet
sleep?**



What stands out as a difference between active sleep and quiet sleep?

Nobody has responded yet.

Hang tight! Responses are coming in.

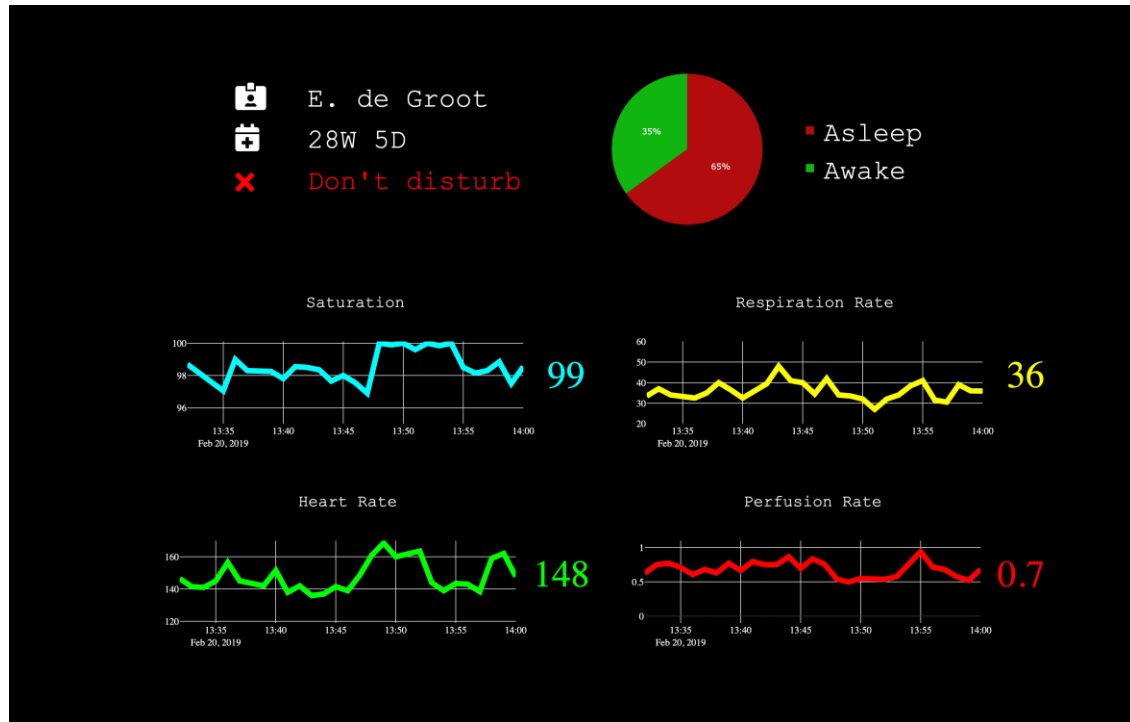
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Word Cloud

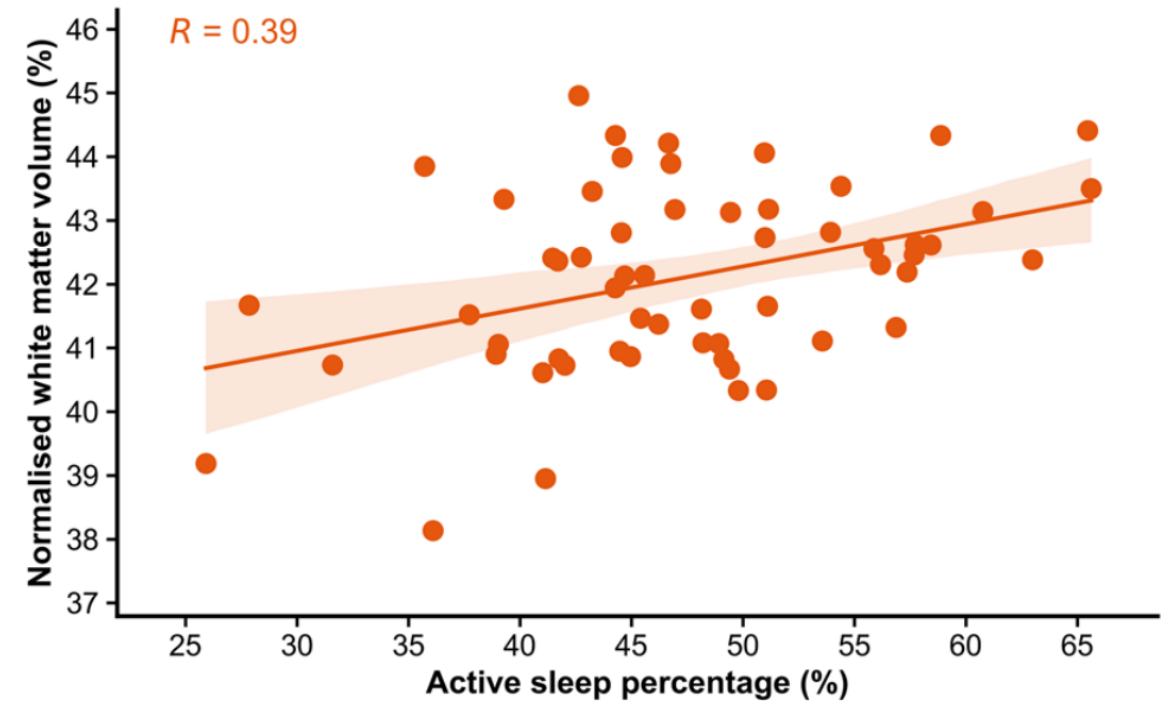
AWAKE



Results using the BeSSPI Sleep Scoring Data:



Sentner et al., 2022



Wang et al., 2024

“One Brain for Life.... All experiences matter!”



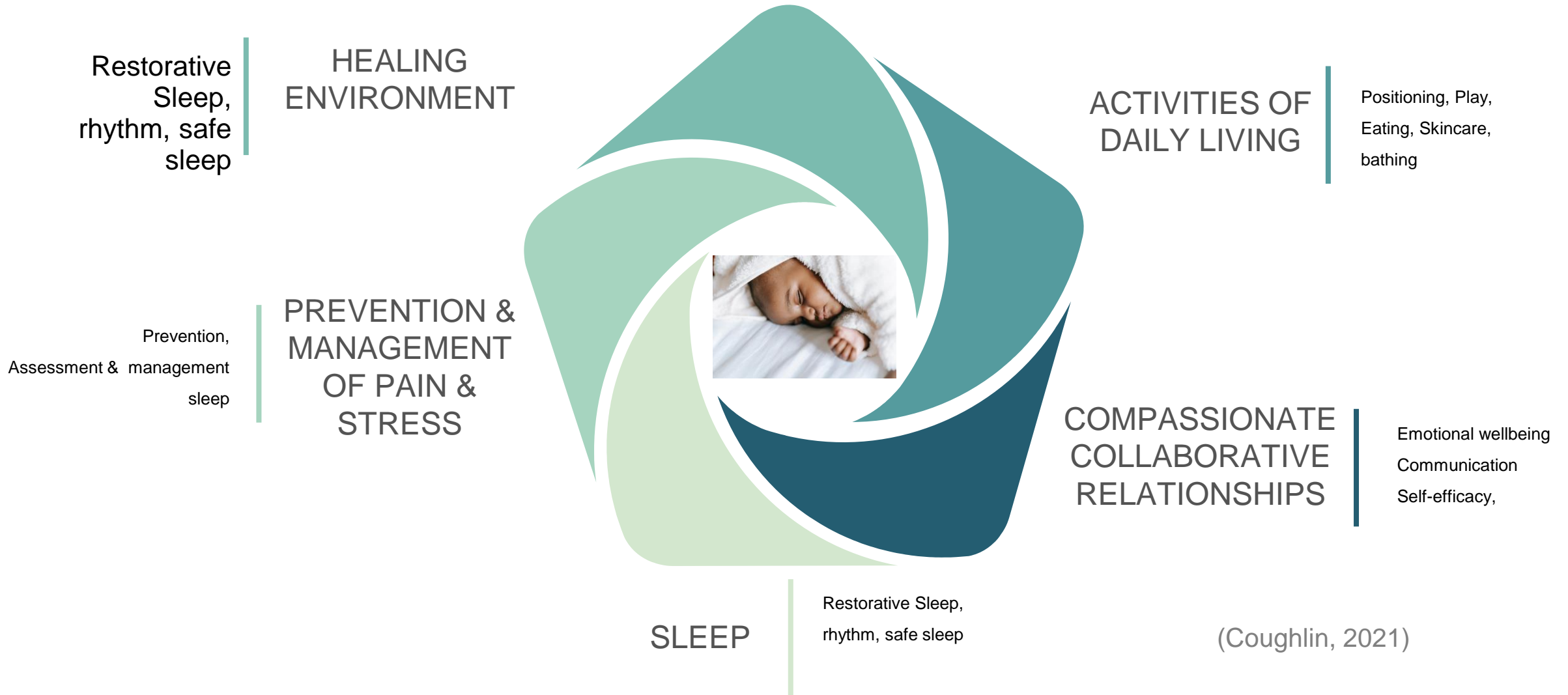
Quote by: Claudine Amiel-Tison & Heidelse Als



**Using a trauma-
responsive
approach...**

**What can you do
to optimize
preterm sleep?**

CORE MEASURES FOR TRAUMA INFORMED CARE | DEFINE TRAUMA-INFORMED DEVELOPMENTALLY SUPPORTIVE PRACTICES BASED IN NEUROPROTECTIVE EVIDENCE BASED PRACTICES



Strategies to Safeguard Sleep in the NICU

	Add	Remove	Change
Sound	<ul style="list-style-type: none"> • Earmuffs¹⁻³ • Music / mother's Voice^{1,4-6} • Noise meter on the ward 	<ul style="list-style-type: none"> • Loud alarms (alarm differentiation)^{1,7} 	<ul style="list-style-type: none"> • Location of alarms • Noisy wheels on carts used by personnel • Procedures (e.g. no equipment on top of incubator)
Light	<ul style="list-style-type: none"> • Incubator covers⁸ • Dimmable light¹ • Circadian rhythm^{1,4,5,9,10} 	<ul style="list-style-type: none"> • Harsh direct light^{1,11} 	<ul style="list-style-type: none"> • Phototherapy lamps to blankets
Feeding	<ul style="list-style-type: none"> • Circadian time stamps on bottles¹²⁻¹⁴ 		<ul style="list-style-type: none"> • Timing of feeding based on cues⁶
Discomfort/ Pain	<ul style="list-style-type: none"> • Support infant¹⁵ • Behavioral Assessment¹⁶ 	<ul style="list-style-type: none"> • Unnecessary (routine) checks and procedures¹⁷ • Obtrusive (skin breaking) procedures 	<ul style="list-style-type: none"> • Suitable pain relief (e.g. facilitated tucking)¹⁵ • Suitable positioning¹⁸
Care	<ul style="list-style-type: none"> • Tactile stimulation^{1,4,5,19,20} • Skin-to-skin care^{1,4-6,19,21} • Developmental care (e.g. NIDCAP)^{4,5,22-28} 	<ul style="list-style-type: none"> • Unnecessary (routine) checks and procedures^{4,17,29} 	<ul style="list-style-type: none"> • Adapting care to sleep cycle^{4,6,17,19,30} • Suitable positioning^{6,19,31}
Knowledge	<ul style="list-style-type: none"> • Education for nurses and parents^{4,5,32} 		<ul style="list-style-type: none"> • Structure of rounds/handovers to include sleep³² • Document sleep in electronic patient file³³



Safeguarding Sleep: A Trauma-Responsive, Neuroprotective Approach:



Use a family centered care approach – (promote parental presence, co-regulation, Kangaroo care, etc.)



↓ stressful procedures and ↓ neonatal pain



Individualized positioning, promote comfort and safety

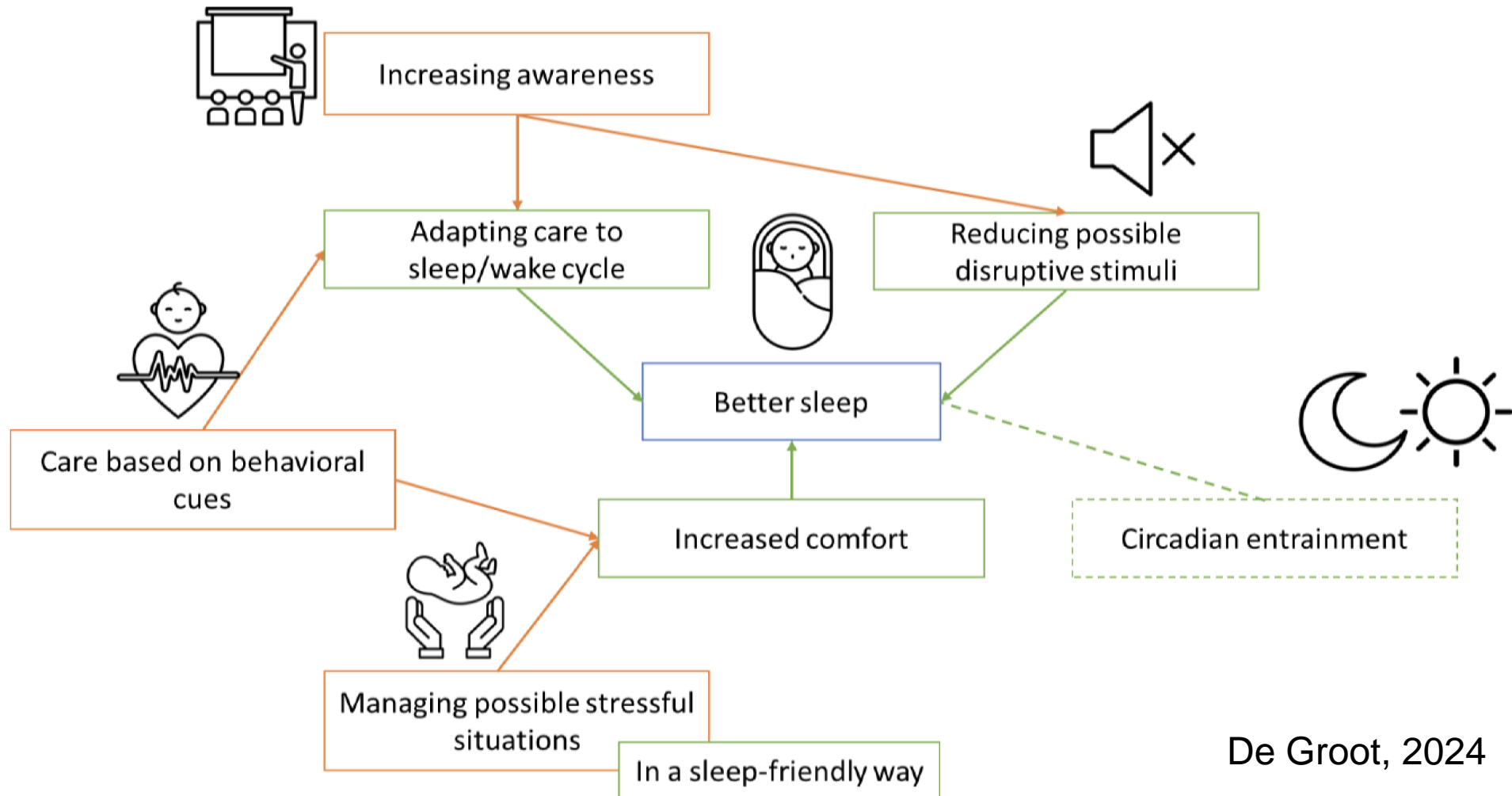


Support a healing environment – reduce noxious stimuli



More Cue-based Care (ADLs)

Interventions to Improve Sleep Quality & Quantity





Sleep Support for Parents: A Trauma-Responsive Approach



**Evidence
Based**



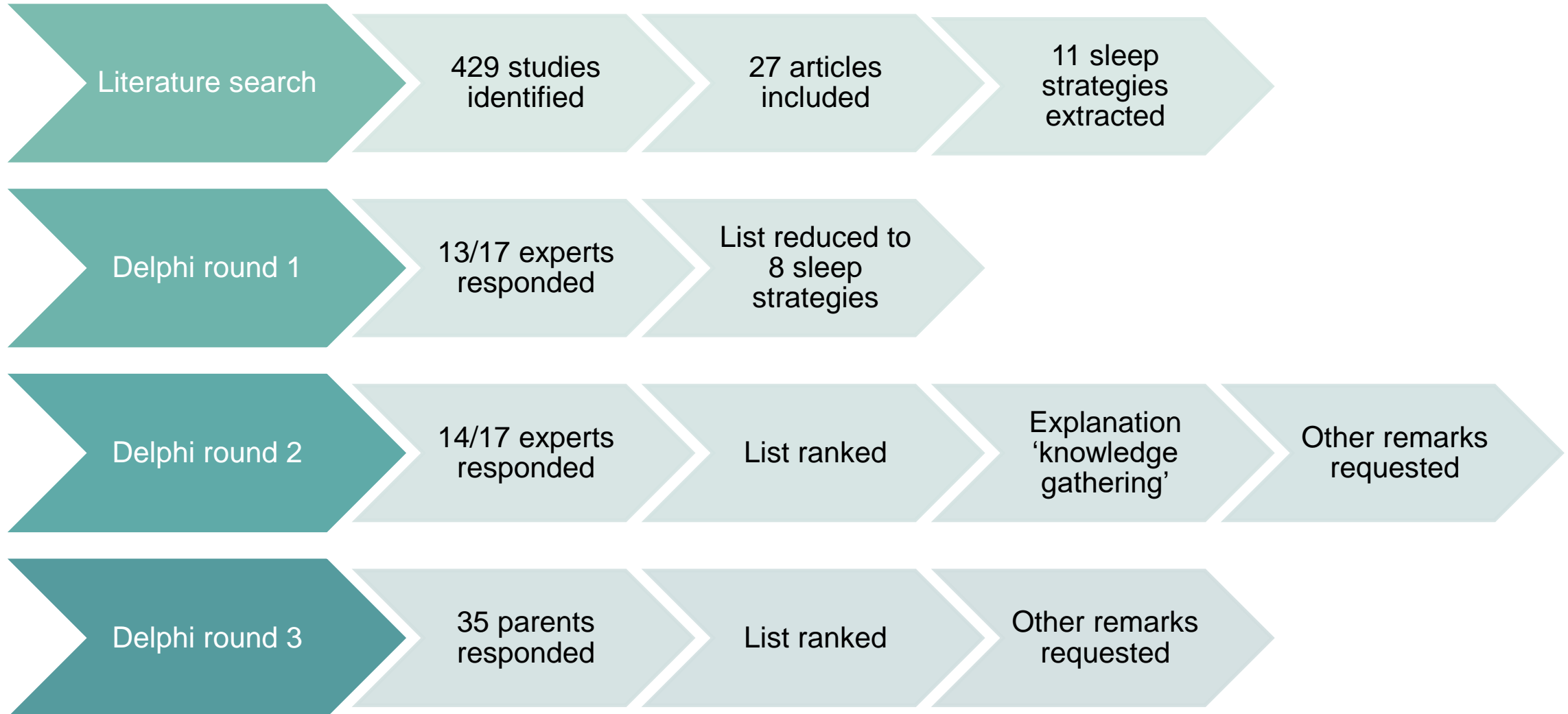
Individualized



**Parent
Empowerment**

Sleep strategies after discharge

Delphi study using evidence based, expert-endorsed and supported by parents



Post-NICU Expert Sleep Strategies:

1 Knowledge gathering

2 Parental role

3 Sleep hygiene

4 Calming and comforting



5 Activities and soothing

6 Natural light

7 Swaddling

8 Sleep diary

Post-NICU Parent Sleep Strategies:

1 Knowledge gathering

2 Parental role

3 Sleep hygiene

4 Calming and comforting



5 Activities and soothing

6 Natural light

7 Swaddling

8 Sleep diary



**What's Can We
Expect in the Future?**

THANK YOU



**Any
Questions?**

