

TWINKLE  
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*little star*



**Sleep in Neonates**  
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# OBJECTIVES

1. Understand the importance of sleep
2. Identify sleep wake states in neonates
3. Understand the factors that contribute to or mitigate sleep disruption

# IMPORTANCE OF SLEEP

- Cognitive function
- Solidifies memories and learning
- Appropriate growth
- Lack of sleep causes irritability, poor emotional regulation, ineffective attention, increased risk for metabolic syndrome



# FETAL SLEEP

- Movements are noted at 7-8 weeks
- Distinct patterns of movement emerge at approximately 15 weeks of age
- Fetuses do appear to have periods of vigorous activity (swallowing, increased heart rate) and periods of rest as young as 20-28 weeks
  - Felt to reflect maternal melatonin
- “sleep” or true wakefulness is suppressed:
  - Warmth
  - Prostaglandins, progesterone metabolites

# SLEEP STATES

	Eyes	Body Movements	Facial Movements	Respirations	EEG Findings	aEEG Findings
Quiet Sleep	Closed	Relatively no body movement	Few rhythmic mouth movements	Regular	Trace alternant (medium to high voltage) 30–200 $\mu$ V	Wide bandwidth
	No eye movements		Relaxed Sighs	Slow		
Active Sleep (AS)	Closed	Slow, small twitches	Frowns and smiles	Irregular	Continuous (low voltage) 30–70 $\mu$ V	Narrow bandwidth
	Rapid eye movements	Low tone between startles	Burst of sucking Some vocalizations			
Transitional Sleep	Periods of opening and closing	Slow startles	Grimace, intermittent sucking	Regular	Continuous (high voltage) 100–200 $\mu$ V	Variable
	Slow eye movements		Increase in vocalizations			
Awake	Open	Rapid startles	Frowns, smiles, grimace, sucks, crying	Irregular	Continuous (medium voltage) 70–100 $\mu$ V	Narrow bandwidth
	Rapid or slow eye movements	Gross motor movements	Vocalization			





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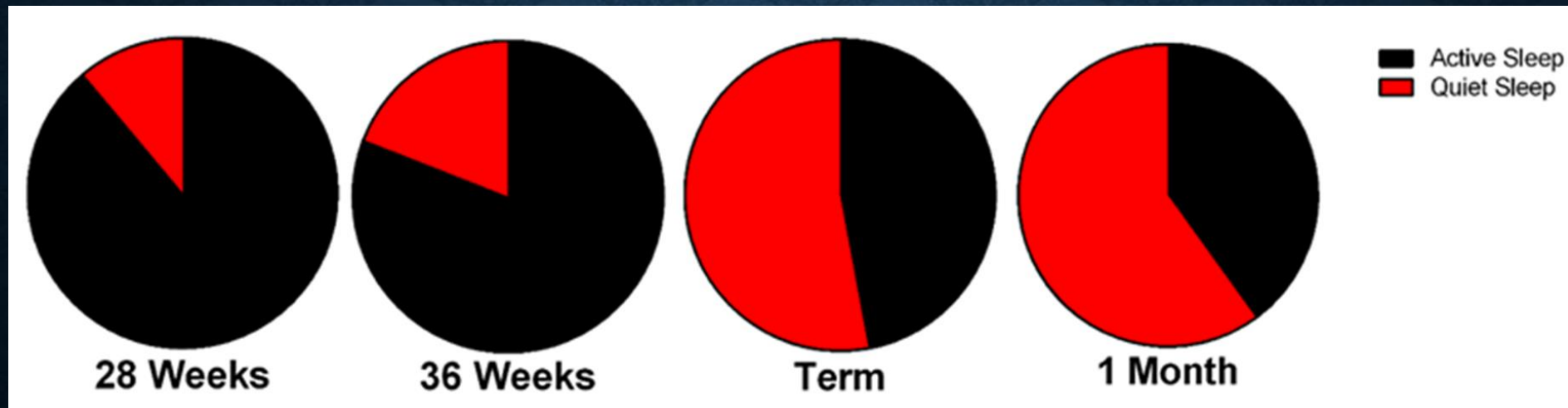


# REM SLEEP IS PARTICULARLY IMPORTANT

- Consolidation of learning
- Active sleep with low REM components found in neonates with developmental delays
- Infants with higher medical risk scores have less REM activity
- Infants with less REM (even with equal “active sleep”) cry more and are more frequently described as “fussy babies”
- Poor neonatal sleep predicts longer gaze duration during new visual memory recognition task and increased distractibility at 18 months
- Premature infants who spent less time in REM sleep, regardless of time spent in active sleep, performed more poorly on the Bayley II.

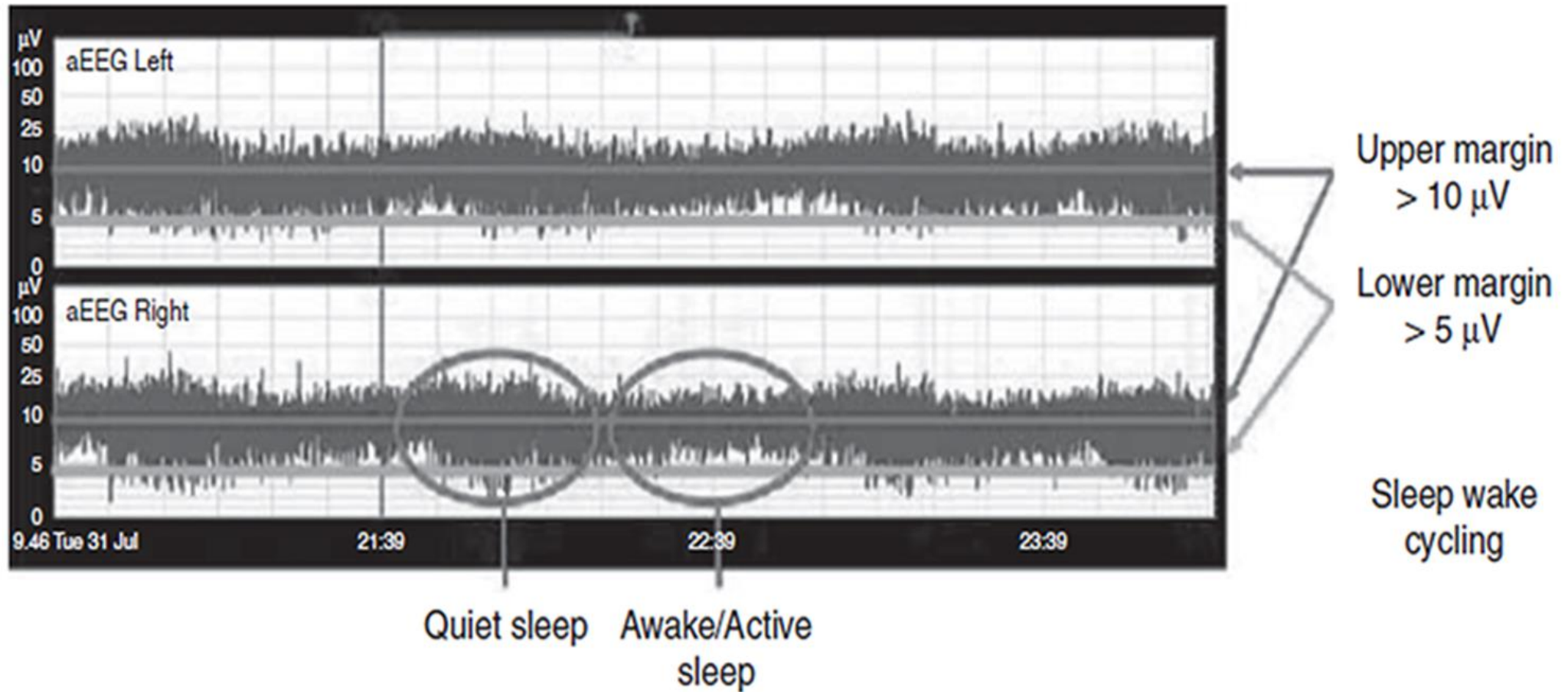
# SLEEP IN THE PRETERM NEONATE

- Premature neonates have periods of active sleep that can be identified on exam and by eeg as early as 25 weeks GA.
- The preterm infant sleeps as much as 90% of the day
  - Full term infants sleep approximately 70% of the day
- Active sleep decreases over time and quiet sleep increases
  - Within the active cycle, REM component increases and non-REM sleep decreases
  - In adults active sleep is entirely REM sleep





# SLEEP WAKE CYCLING AEEG





# SLEEP IN THE NICU

- NICU environment itself disrupts sleep:
  - Frequent interventions
  - abnormal day/night cycles
  - around the clock lighting
  - frequent chaotic noise disturbs sleep for infants in the NICU
  - Hands on care that is not bundled
- Majority of provider interactions resulted in complete awakenings
  - Accompanied by hypopnea, apnea or desaturation
  - Particularly vulnerable to apnea during active sleep

# DISORDERS AFFECTING SLEEP

Disorder	Overview	How Sleep is Affected	Comments
<b>Hypoxic-Ischemic Encephalopathy</b>	Brief disruption of blood flow to the infant brain can have a profound effect on neurodevelopment.	<div>Delayed SWC- progressive with worse injury</div> <div>Decreased AS</div>	Infants undergoing cooling who developed SWC by 36 h of age had better outcomes
<b>Congenital Heart Disease</b>	Many anatomic cardiac defects produce hypoxemia	Delayed SWC for age	May be accompanied by HIE, prolonged hospitalization and surgery, which also complicate sleep
<b>Neonatal Abstinence Syndrome (NAS)</b>	Prenatal illicit or prescription drug exposure is becoming an increasing concern	<div>SSRI: More AS and increased motor activity during AS</div> <div>Opiate: more AS, low threshold for arousal, fragmented sleep</div>	
<b>Inborn Errors of Metabolism</b>	A family of disorders caused by enzyme deficiencies in the metabolic pathways	Spectrum of pathology from no cycling to normal cycling depending on enzyme deficiency	Encephalopathy itself alters the aEEG
<b>Chronic Lung Disease</b>	Babies with prolonged oxygen needs	<div>Lower saturations while asleep</div> <div>Increased respiratory events and arousals during sleep</div>	Infants on oxygen should be evaluated while asleep before discontinuation

# INTERVENTIONS TO PROTECT SLEEP

Protective intervention	Overview	How Sleep is Affected	Comments
Kangaroo Care	Placing an infant skin to skin with a parent provides warmth and familiar stimulation	More mature SWC More time asleep Fewer arousals	
Infant Massage	Various techniques: firm pressure, gentle stroking, containment	Increased sleep state and decreased awake state	
Light Modification	Intensive care unit is inherently bright	Cycled light long term associated with differences in day night activity	Cycled light > Full darkness > Full light
	Options are to provide day/light patterns for light or to reduce light	Longer night time sleeping	
Sound Modification	Intensive care unit is inherently noisy	Episodes of noise can cause arousals	Live music, either mother singing or instruments in the unit, associated with best outcomes
	Can decrease noxious noise or increase pleasant noise	music improved infant sleep	



# POSITIONING/CONTAINMENT

- Preterm infants with improved sleep in the prone position
- Positioning to promote sleep and decrease arousals



# QUESTIONS?

