



# *Pediatric Sleep: what should we know?*

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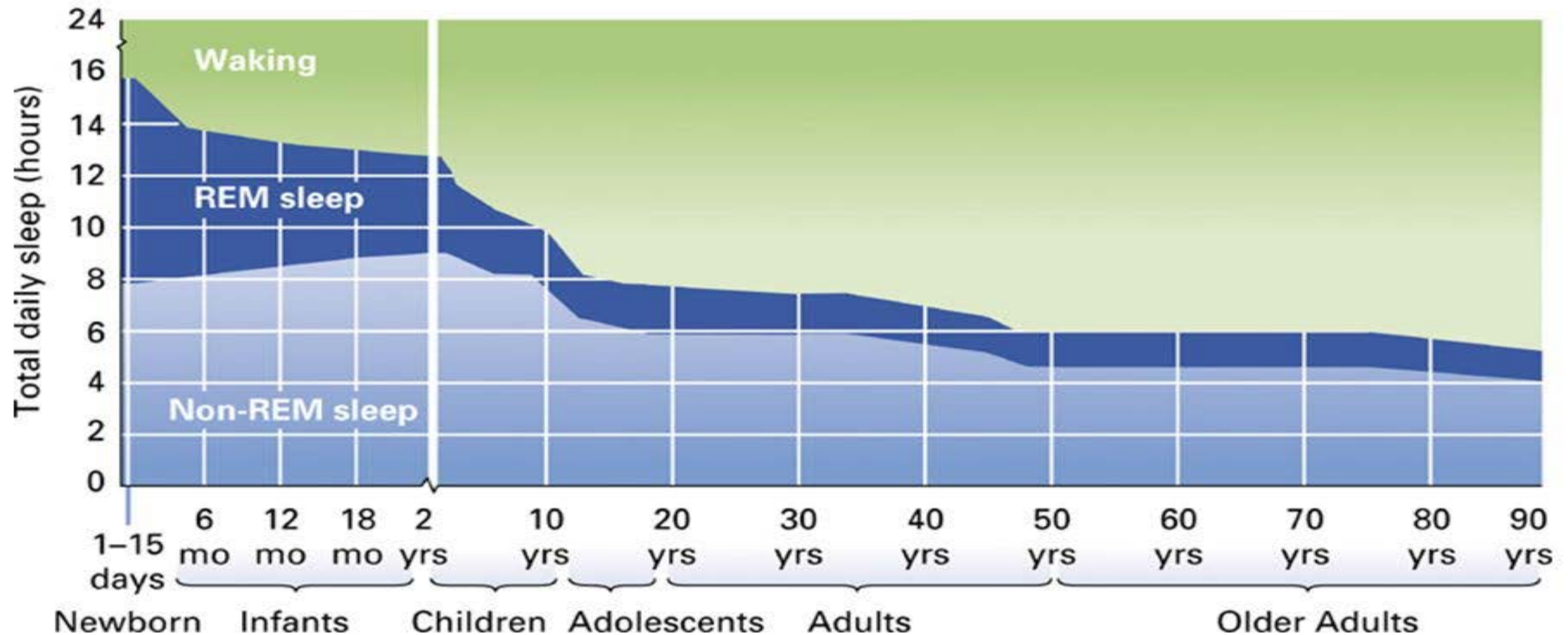
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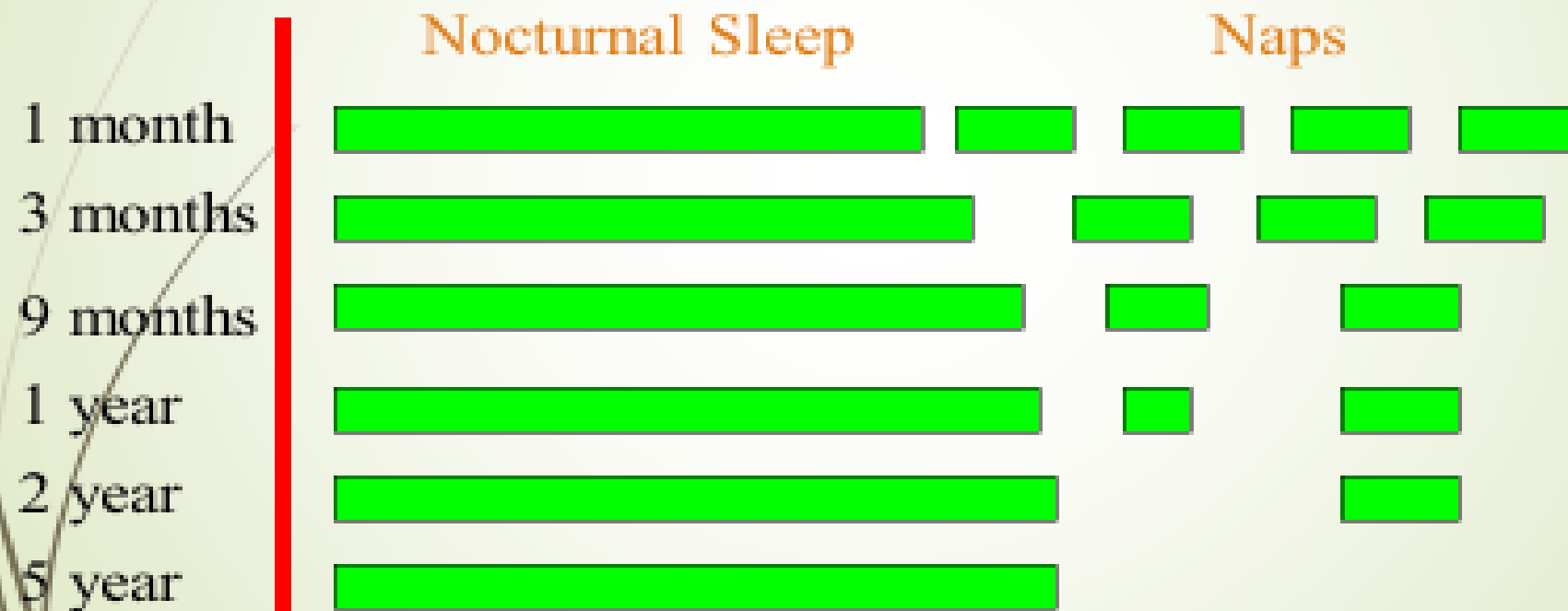
# *Objectives*

- ▶ How sleep changes with age
- ▶ Sleep hygiene, sleep requirements
- ▶ Frequent sleep disorders: insomnia, hypersomnia conditions, sleep disordered breathing, parasomnias
- ▶ sleep studies in children, indications and difficulties

# Sleep Across the Human Life Span

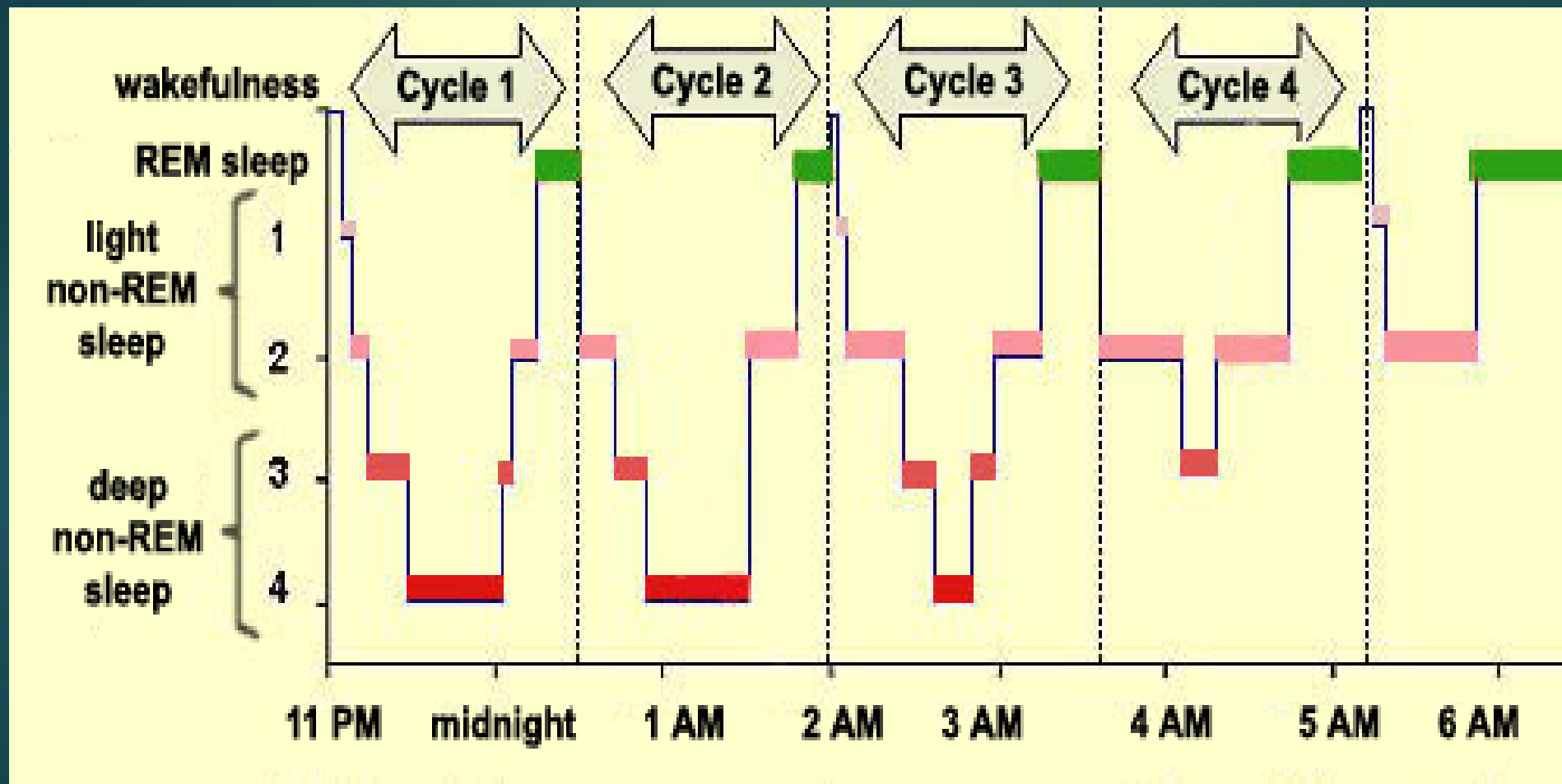


# Sleep Architecture in children



Ferber et al.

# Hypnogram



# *Prevalence of pediatric sleep conditions*

## ***In 2-18 y of age:***

- ▶ Night terrors 40% (2-12 y of age)
- ▶ Nightmares 30% (<5y of age)
- ▶ Sleepwalking 30% (3-10 y of age)
- ▶ Insomnia (sleep onset and maintenance) 30%
- ▶ Bedtime resistance 15% (school age)
- ▶ Periodic limb movement disorder/RLS 5-10%
- ▶ Snoring 10%
- ▶ Obstructive Sleep Apnea (OSA) 1-2%
- ▶ Narcolepsy 0.05%

*Sleepwalking and other parasomnia in children. UpToDate Sept 2017*

*Pediatric Sleep Disorders. Sufen Chiu MD. Medscape 2014.*

# *Clinical cases.....*



# Case study.....Amber



- ▶ Amber is a 4 y old girl is in for a well child check. She has no medical problems. Since she started preschool 3 months ago, she has difficulty falling asleep and wakes up several times during the night. One parent reads her stories at bedtime (7 pm) for at least 30 min. She will come out of her room after the parent leaves and most of the time the father ends up staying with her until she falls asleep (8:30-9 pm). She wakes up at night and goes to the parents' room.
- ▶ The mother gets up and stays with Amber until she falls back to sleep. (Amber wakes up at 7:30 am, and takes a 2 hr nap during the day). Amber is not tired during the day.
- ▶ Her VSs are normal and her physical exam is remarkable for 2+ tonsil size.

# *Types of Insomnia*

- ▶ Behavioral insomnia of childhood
  - sleep onset association disorder type
  - limit setting type
- ▶ Poor sleep hygiene
- ▶ Delay Sleep Phase Syndrome
- ▶ Psychophysiological insomnia, depression/anxiety
- ▶ Secondary to a sleep disorder: i.e. OSA, PLMD
- ▶ Secondary to medications (stimulants etc.)

## *Case study.....Alex*



- ▶ Alex is a 10 y old boy with ADHD. Parents are divorced, he spends every other week-end with the father. Alex has trouble falling asleep, he goes to bed at 9 pm. He stays in his bed, he reports it takes up to 2 hrs to fall asleep, he watches TV. He reports sometimes he wakes up in the middle of the night for a “long while”, he watches TV. The mother has noticed he is restless while asleep, he snores softly. He is tired when he has to get up at 6:30 in the morning.
- ▶ He has trouble in school with learning and concentration. The teacher reports he is irritable, has behavioral problems.
- ▶ PE: he is thin, a little anxious. VSS. Tonsils 2+ in size, low soft palate. He is on Vyvance 50 mg in the morning and Adderall 10 mg at 2-3 pm.

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## *Case study.....Betsy*



- ▶ Betsy is 15 y old. She goes to bed at 11 pm but cannot fall asleep. She is active on social media for about an hour, then she listen to the music but cannot fall asleep until 1-2 am.
- ▶ She has to wake up at 6 am for school. It is hard to get her out of bed. She falls asleep in school especially in the morning.
- ▶ Betsy had difficulty completing her school assignments because she is always so tired, her grades are falling.
- ▶ She sleeps past noon during weekends. She used to sleep well when younger.
- ▶ PE: normal

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# Consequences



Cognition/  
Learning

Mental Health

Quality of  
Life

Physical  
Health



# Assessment of Insomnia



**Ref:** Effectiveness and Cost-effectiveness of an Educational Intervention for Practice Teams to deliver Problem Focused Therapy for Insomnia: Pilot Cluster Randomised Trial

## TWO WEEK SLEEP DIARY

### INSTRUCTIONS:

1. Write the date, day of the week, and type of day: Work, School, Day Off, or Vacation.
2. Put the letter "C" in the box when you have coffee, cola or tea. Put "M" when you take any medicine. Put "A" when you drink alcohol. Put "E" when you exercise.
3. Put a line (I) to show when you go to bed. Shade in the box that shows when you think you fell asleep.
4. Shade in all the boxes that show when you are asleep at night or when you take a nap during the day.
5. Leave boxes unshaded to show when you wake up at night and when you are awake during the day.



**SAMPLE ENTRY BELOW:** On a Monday when I worked, I jogged on my lunch break at 1 PM, had a glass of wine with dinner at 6 PM, fell asleep watching TV from 7 to 8 PM, went to bed at 10:30 PM, fell asleep around Midnight, woke up and couldn't get back to sleep at about 4 AM, went back to sleep from 5 to 7 AM, and had coffee and medicine at 7:00 in the morning.

Today's Date	Day of the week	Type of Day Work, School, Off, Vacation	Noon	1PM	2	3	4	5	6PM	7	8	9	10	11PM	Midnight	1AM	2	3	4	5	6AM	7	8	9	10	11AM
sample	Mon.	Work		E					A				I									C				
	Mon	work						E	E						I									C		C
	Tue	work	C				E			A					I									C	C	
	wed	work	C	C					E						I										C	
	Thu	work		C							A	A		I										C	C	
	Fri	work	C				E							I												
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	Sun	off	C	C	C		E	E				C											C	C		
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	Tue	work						E			A				I									C		
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	Fri	work									A	A				I										
	Sat	off	C		E	E				A																
	Sun	off	C			C									I								C	C	C	

# Actigraphy

- An actigraph is a wrist-watch like device with an accelerometer used to measure movement.
- Computer algorithms are used to interpret accelerometer-based findings as measures of sleep and waking.
- Actigraphy has become an increasingly popular method for estimating sleep parameters in both research and clinical studies over the past 30 years.



# *Behavioral Insomnia of Childhood: Amber*

*Sleep onset association disorder in infants, Limit-setting sleep disorders in toddlers*

- ▶ Learned behaviors due to parental influence= the parents contribute to the insomnia with their response to the child
- ▶ Includes both sleep onset and sleep maintenance insomnia
- ▶ Can be prevented by putting child to bed drowsy but not asleep (infants) or establishing limits and gradually reducing the interaction with the child after bedtime (toddlers)



## *Mixed causes: Alex*

- ▶ Poor sleep hygiene
- ▶ Psychophysiological insomnia, depression/anxiety
- ▶ Secondary to a sleep disorder: i.e. OSA, PLMD: **to be ruled out**
- ▶ Possibly contributed by late dose of stimulant



# *Delay Sleep Phase Syndrome: Betsy*



- ▶ Circadian rhythm disorder
- ▶ Habitual sleep-wake times are delayed, usually > 2 hrs, relative to conventional clock times
- ▶ Typical of adolescents. Natural shift of the melatonin secretion
- ▶ The internal clock is re-set: “Normal sleep at the wrong time”
- ▶ Results in daytime somnolence and inability to fall asleep at a normal time
- ▶ Tx: Light therapy, chronotherapy with melatonin

*Clinical practice guideline for the treatment of intrinsic circadian rhythm sleep-wake disorders.an update for 2015. AASM Clinical Practice Guidelines*

# Management of insomnia

- ▶ Focus on possible aggravating factors (caffeine, pm dose of stimulants etc) or underlying condition
- ▶ Psychoeducation, discuss expectations
- ▶ Adjust the sleep schedule/hygiene
- ▶ Behavioral intervention (behavioral modifications, CBTI)
- ▶ Rule out a sleep condition
- ▶ Consider iron deficiency (brain): *can cause insomnia, restless sleep and PLMS. Low ferritin lev (<50 mcg/ml), ferritin is reflective of iron stores (Low brain iron= Dopamine receptors and transporters are altered as are behaviors related to this neurotransmitter).*
- ▶ No FDA approved medications for children

# Medications

- ▶ Anti histamines (diphenhydramine, hydroxyzine etc.)
- ▶ Melatonin
- ▶ Alpha-adrenergic agonists (Clonidine, guanfacine)
- ▶ Atypical antidepressants (Trazodone, Mirtazepine)
- ▶ Benzodiazepine (BZDs) (triazolam, estazolam, temazepam, lorazepam, flurazepam)- GABA receptor agonists
- ▶ Non BZD receptor agonists (Zolpidem, Zaleplon, Eszopiclone)
- ▶ Gabapentin
- ▶ Selectively-acting synthetic melatonin receptor agonist- Ramelteon
- ▶ Suvorexant: orexin receptor agonist (for maintenance insomnia)
- ▶ Doxepin: tricyclic antidepressant and selective histamine receptor agonist (long  $\frac{1}{2}$  life: 15 hrs, for maintenance insomnia), no abuse potential

## Case study.....Jack

- ▶ Jack is a 15 y old with c/o chronic fatigue and excessive daytime somnolence, since he started school 6 months ago. Bedtime is 11 pm and he has to get up at 6 am. It takes 1 hr to fall asleep. He snores every night. He has to be called several times in the morning before he gets up. He falls asleep in school, almost every day, especially during morning classes. His grades have dropped when compared to the previous school year. He takes a nap after school. He drinks 2 beverages with caffeine every day.
- ▶ On exam his VSs are normal and his exam is remarkable for pale edematous nasal mucosa and tonsils 2-3+ in size.



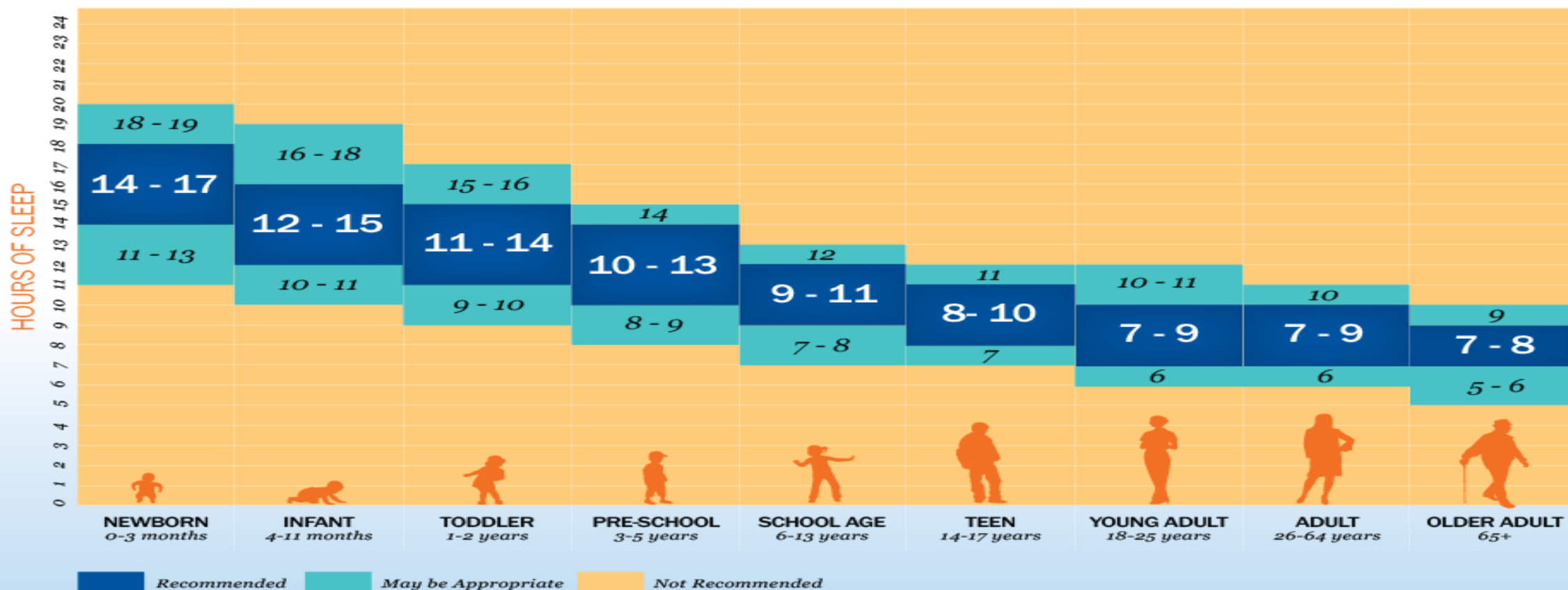
# *Causes of hypersomnia....*

- ▶ Inadequate sleep hygiene
- ▶ Insufficient sleep syndrome
- ▶ Poor sleep quality due to a sleep disorder (OSA, PLMD etc.)
- ▶ Medications' side effect (antipsychotics, AEDs, guanfacine etc)
- ▶ Recreational drugs use (cannabinoids)
- ▶ Circadian rhythm sleep disorder (i.e. Delay Sleep Phase Syndrome)
- ▶ Depression/anxiety
- ▶ Idiopathic hypersomnia
- ▶ Narcolepsy
- ▶ Hypothyroidism
- ▶ Post-traumatic hypersomnia (head trauma)

# *Good sleep hygiene*

- ▶ Keeping the room quiet, dark, and comfortable
- ▶ Practicing a simple bedtime ritual
- ▶ Limiting time spent in bed while awake
- ▶ Not eating or drinking heavily for about 3 hours before bedtime
- ▶ Removing distractions, such as television, tablet, phones for at least 2 hrs before bedtime
- ▶ Avoiding medications that affect sleep and caffeine
- ▶ Considering the effect of sleep partners (including pets)
- ▶ Maintaining a consistent sleep schedule
- ▶ Avoiding daytime naps (after 5 y of age)
- ▶ Exercising regularly
- ▶ Taking a hot bath or drinking something warm before bedtime

# SLEEP DURATION RECOMMENDATIONS



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# *Hypersomnia management*

- ▶ Improvement of sleep hygiene
- ▶ sleep length to meet requirement for age
- ▶ Gradually advance the bedtime
- ▶ Consider using melatonin as chronotropic agent
- ▶ Provide a sleep diary to monitor changes
- ▶ If still somnolent after sleep schedule improvement, consider the possibility of a sleep disorder (OSA, PLMD, narcolepsy or idiopathic hypersomnia)
- ▶ May need a sleep study and MSLT to rule out a sleep disorder , narcolepsy or other hypersomnia condition.

# Narcolepsy

- ▶ Incidence: 0.05% (1.37/100,000/yr)
- ▶ M:F same
- ▶ Symptoms start in childhood or young adults (peaks 14.7 y and 35 y)
- ▶ In children: 34% of pts had onset of symptoms <15 y of age, 4.5% before age 5y
- ▶ decrease or lack of hypocretins (Orexins)- hypothalamic neuropeptides
- ▶ Secondary form: neurologic disorders/trauma

*The diagnosis and treatment of pediatric narcolepsy. S Nevsimalova - Current neurology and neuroscience reports, 2014.*

# *Pediatric Narcolepsy*

## *Narcolepsy tetrad:*

- ▶ Excessive Daytime Sleepiness
- ▶ Cataplexy
- ▶ Sleep paralysis
- ▶ Hypnagogic Hallucination

## *Childhood narcolepsy:*

- ▶ Cataplexy 25% but may develop later
- ▶ Nonspecific symptoms --- sleepiness, learning disability, poor concentration, emotional lability, social isolation, depression
- ▶ Dx: sleep study and MSLT (multiple sleep latency test)

## *Case study: Tiffany*

- ▶ Tiffany is 5 y old, she is brought in for evaluation of night awakenings. She has woken screaming in each of the past 3 nights about 1 hr after going to sleep. When her parents go to her room, she is crying, sweating, and looks frightened. She does not respond to her parents and does not seem fully awake. When her parents hold her, she does not calm down but after a while she goes back to sleep. The next morning she does not recall the incident. She just started kindergarten and has begun going all day without taking a nap.
- ▶ On exam she is afebrile and her VSs are normal, PE unremarkable.

# *Which one?*

- ▶ 1) Nightmare
- ▶ 2) Confusional arousal
- ▶ 3) Night terror
- ▶ 4) Seizure

# Differential diagnosis

- ▶ ***Parasomnia***

- Night terrors

- Nightmares

- Confusional arousals

- Sleep talking

- ▶ ***Seizures*** (throughout the night, brief episodes, stereotypical movements)

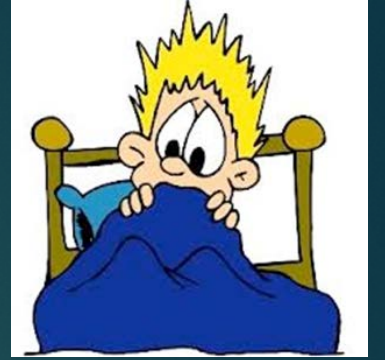
# Night Terrors

*Abrupt episode of screaming, agitation, crying, sweating...*

- ▶ Occur in stage 3 & 4
- ▶ Occur first ½ of the night
- ▶ Often loud cry, scream, diaphoresis
- ▶ Amnesia the next day
- ▶ 60% have family history
- ▶ Can be triggered by other sleep disorders, caffeine, stress/anxiety, sleep deprivation.



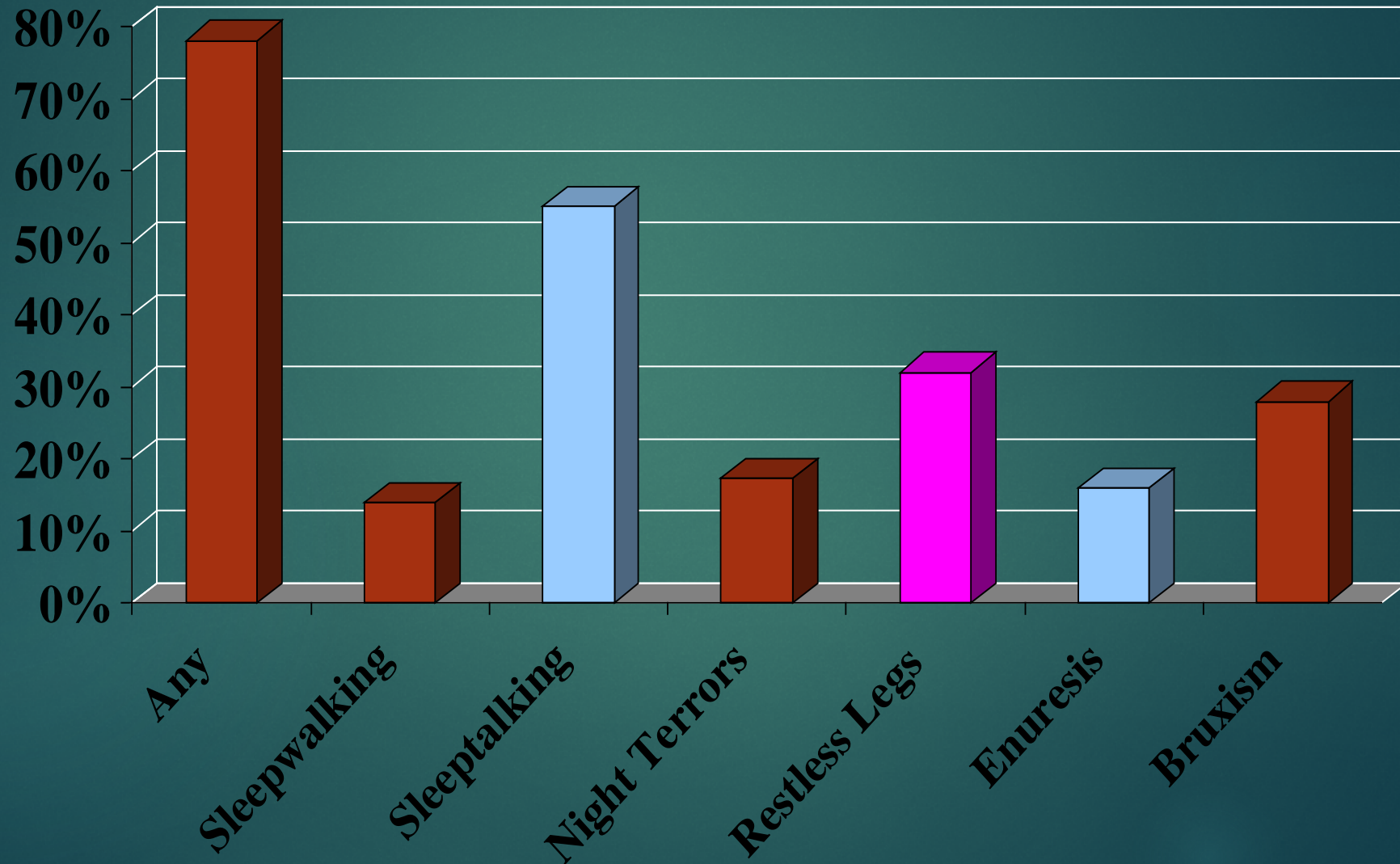
# Nightmares



*Vivid, frightening dream that usually awakens the dreamer (may involve fear, anxiety, terror etc.)*

- ▶ Very common, peak 3-6 y of age
- ▶ From REM sleep
- ▶ Occurs in the last ½ of night
- ▶ Usually remember the next day
- ▶ Easy to arouse
- ▶ Oriented when awakened

# Parasomnias in childhood



# Parasomnia Management

*Sleep terrors, talking, walking, nightmares, confusional arousals, head banging, body rocking.....*

- ▶ Reassurance-education: they tend to improve and resolve over time. Family history.
- ▶ Discuss how to secure the environment (around the bed, door bell, gates for stairs etc)
- ▶ Identify triggers (sleep deprivation, caffeine, a sleep disorder, scary shows at bedtime, stress)
- ▶ Sleep study if suspecting a sleep disorder or seizures
- ▶ Severe cases --- Benzodiazepine, Trazodone, Paroxetine

## *Case study: Michael*



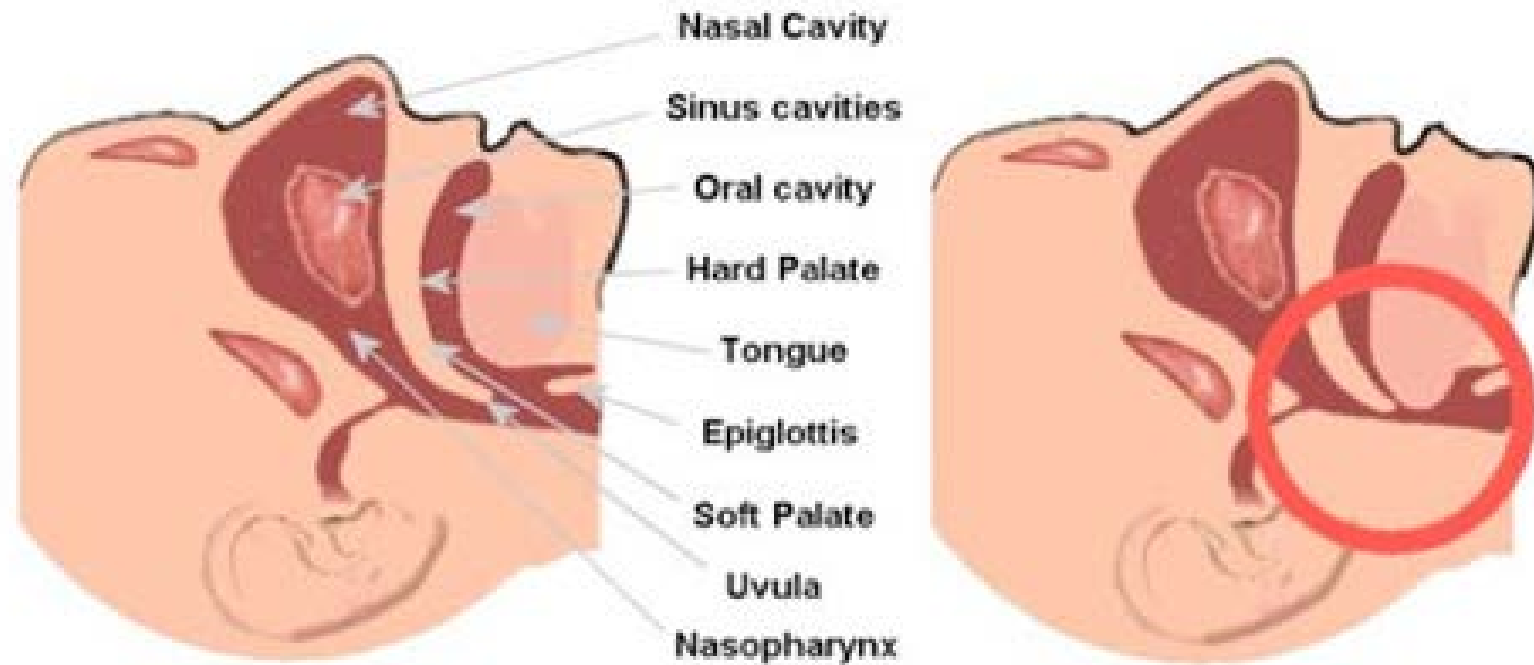
- ▶ Michael is 6 y old boy with Down syndrome has been referred due to snoring for the past 2 years. He snores mod-loudly and has occasional pauses of his breathing followed by gasps to catch his breath. He is restless during sleep. He is tired but not sleepy during the day. The teacher reports aggressive behavior and some hyperactivity.
- ▶ P.E.: normal VSs, BMI at 95%tile, tonsils 3+ in size

# *Pediatric OSA: symptoms and signs*

- ▶ Snoring
- ▶ Increased respiratory efforts
- ▶ Sleep disruption
- ▶ Sleep position dependent labored breathing
- ▶ Nocturnal sweating, enuresis
- ▶ Daytime sleepiness
- ▶ Hyperactive behavior, learning problems
- ▶ Failure to thrive or obesity
- ▶ Unexplained systemic or pulmonary hypertension

*C. Marcus. Diagnosis and treatment of childhood obstructive sleep apnea. Pediatrics; 130: 576, 2012.*

# Sleep Apnea



**Normal Breathing**

**Blocked Airways**

# *Pediatric OSA*

## *Risk Factors*

- ▶ Adenoidal and tonsillar hypertrophy
- ▶ Obesity
- ▶ Craniofacial syndromes
  - Down syndrome, cleft palate, micrognathia,  
cranio- synostoses, mucopolysaccharidoses
- ▶ Neuromuscular disease
  - Muscular dystrophies, SMA, CP

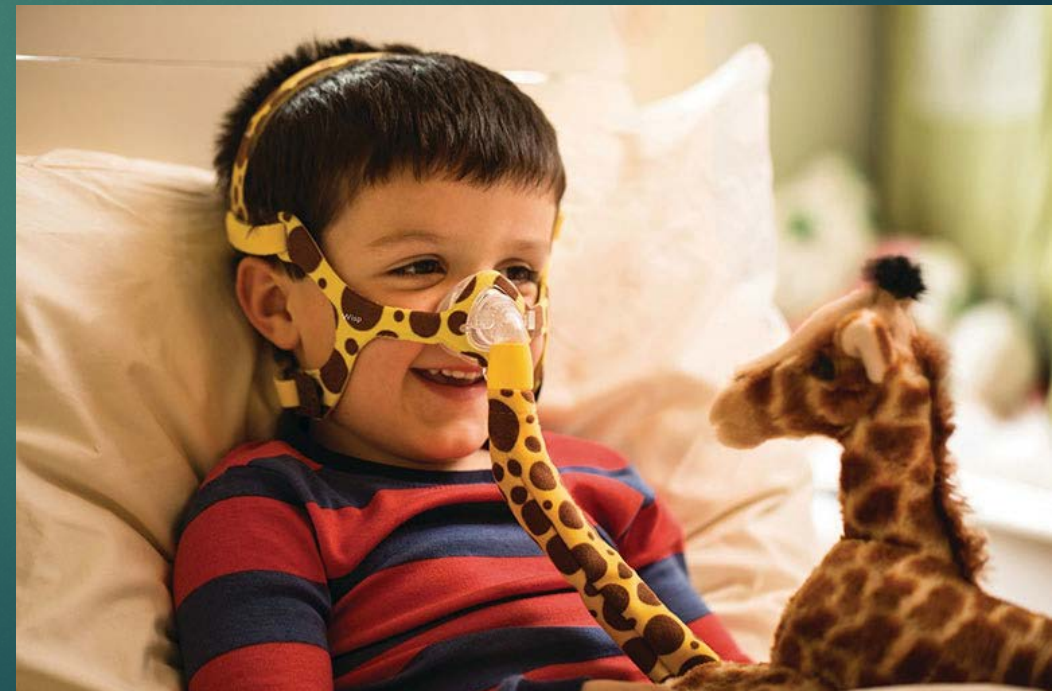
# *Pediatric OSA*



# OSA Management

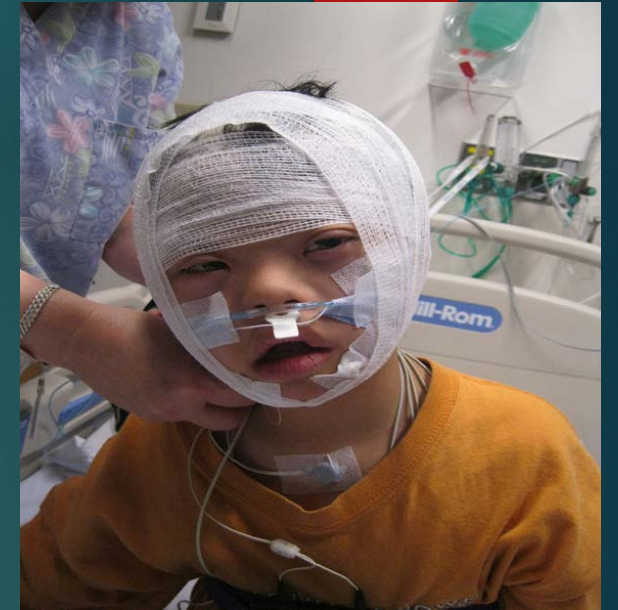
**Dx:** sleep study is the gold standard

- ▶ Adeno-tonsillectomy, lingual tonsillectomy
- ▶ CPAP/BiPAP, HFNC
- ▶ Supplemental oxygen- temporary treatment
- ▶ (Dental devices), myofunctional therapy
- ▶ Weight control – long term treatment
- ▶ Down's: treat hypothyroidism if present
- ▶ Consider Sleep Endoscopy in more difficult cases



# *Sleep study*

- ▶ Simultaneous recording of several physiologic parameters during sleep: EEG, chin/limbs EMG, SpO2, ETCO2 or TCO2, nasal/oral airflow, chest/abdominal movements, HR, RR, body position
- ▶ Video recording
- ▶ Should last at least 4 hrs to be reliable



# *Indications for a sleep study*

- ▶ Daytime somnolence, chronic fatigue, behavioral problems
- ▶ Chronic snoring, observed apnea during sleep
- ▶ Restlessness during sleep
- ▶ Concern for nocturnal seizures
- ▶ Perception of un-refreshing sleep
- ▶ Certain conditions even if no symptoms: Chiari I malformation, Down syndrome, achondroplasia and other genetic conditions
- ▶ Presence of muscle weakness
- ▶ Reassessment after treatment for OSA, PLMD etc.
- ▶ Periodic monitoring for certain conditions

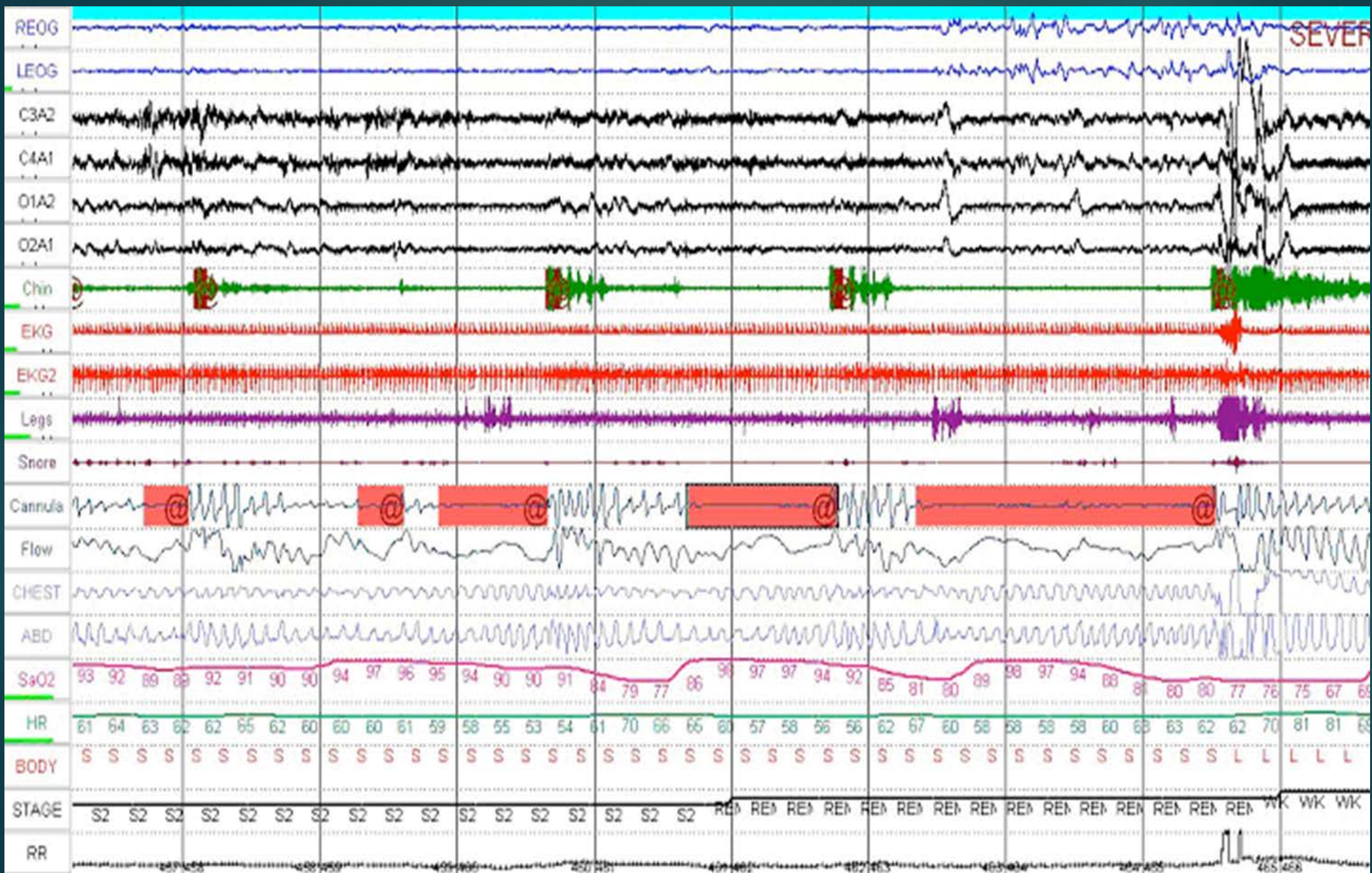
# *How to prepare for the sleep study*

## *Patient's preparation:*

- ▶ Sleep schedule may need adjustment
- ▶ Pts with insomnia need to be treated before the sleep study
- ▶ No nap, caffeine before the sleep study (especially in case of a long drive)
- ▶ “Regular” sleep promoting agents should be used before the study
- ▶ Parents need to know what to expect (especially for young children)
- ▶ Pts with sensory issues may need desensitization before the sleep study (we provide that service for free, need to contact us or sleep lab)

## *Sleep lab preparation:*

- ▶ Sleep technologists with special expertise
- ▶ Special equipment
- ▶ Sleep lab can accommodate but need to prepare for special situations
- ▶ A tour of the sleep lab can be arranged before the sleep study



# *Referrals to the pediatric sleep clinic*

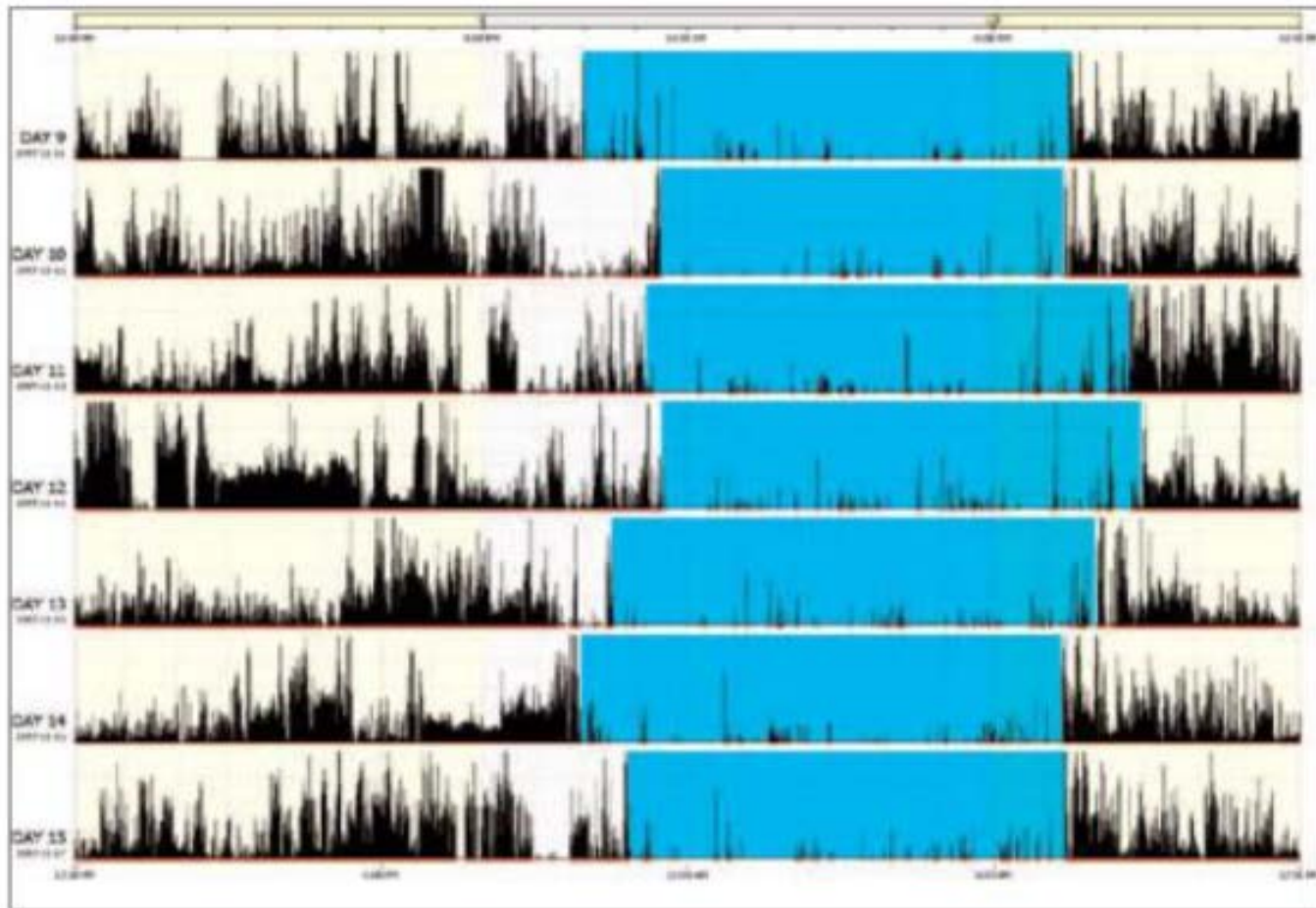
- ▶ Insomnia at bedtime
- ▶ Frequent awakenings at night
- ▶ Restlessness during sleep
- ▶ Sleep walking, talking or agitation during sleep
- ▶ Snoring, apnea
- ▶ Enuresis
- ▶ Excessive daytime somnolence
- ▶ Chronic fatigue
- ▶ Hyperactivity/behavior problems associated with perceived poor sleep
- ▶ Abnormal sleep study

# *Additional References*

- ▶ Lisa J. Meltzer. Prevalence of diagnosed sleep disorders in pediatric primary care practices. Pediatrics June 2010, vol 125(6)
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## Data Example: Normal Sleeper



# What does this actigraph result show?

