Evaluation of the Sleepy Child: What to Do When the Sleep Study is Normal

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Disclosures

Medtronic – Consultant
– There will be no discussion of Medtronic devices in this talk
Objectives

1. Describe the appropriate clinical assessment of the sleepy child
   • screening questions/ questionnaires
   • exam findings
   • testing to screen for non-SDB causes of daytime sleepiness in children
Objectives

2. Be familiar with the incidence, identification and impact of medical conditions that contribute to daytime tiredness including:
   • narcolepsy
   • nocturnal seizures
   • restless leg syndrome
   • circadian rhythm disorders

3. Recognize the importance of adequate sleep hygiene and review the components of good sleep habits
Practice Change

Recognize the need to extend the number of hours of sleep for most children
Evaluation of the Sleepy Child
Evaluation of the Sleepy Child

- Epidemiology
- What does a sleepy child look like?
- History
- Physical Exam
- Differential Diagnosis
- Role of PSG

Goal = Broaden our view of the causes of sleepiness
Pediatric Sleep Disorders

- Insomnia
- Sleep-related Breathing Disorders
- Hypersomnia (not related to breathing)
- Circadian Rhythm Disorder
- Parasomnia
- Sleep-Related Movement Disorders
Sleep Disorders

- **Insomnia:**
  - 307.42 Psychophysiological (Conditioned) Insomnia
  - 307.41 Adjustment Sleep Disorder
  - **307.41 Inadequate Sleep Hygiene**
  - 307.42 Behavioral Insomnia of childhood
  - 995.2 Insomnia due to drug effect
Pediatric Sleep Disorders

**Hypersomnia (not related to breathing):**
- 347.01 Narcolepsy with cataplexy
- 347.00 Narcolepsy without cataplexy
- 780.54 Recurrent Hypersomnia (Klein-Levin Syndrome)
- 780.54 Idiopathic Hypersomnia
- 995.2 Hypersomnia due to drug effect
- 307.44 Hypersomnia due psychiatric condition
Pediatric Sleep Disorders

Circadian Rhythm Disorder:
- 780.55 Delayed Sleep Phase Syndrome
- 780.55 Advanced Sleep Phase Syndrome
- 780.55 Irregular sleep wake type
- 995.2 Circadian Rhythm disorder due to drug effect
- 780.55 Circadian rhythm disorder due to a known physiologic condition
Pediatric Sleep Disorders

Sleep-Related Movement Disorders:
- 333.99 Restless Leg Syndrome
- 780.58 Periodic Limb Movement Disorder
- 780.58 Sleep-Related Leg Cramps
- 780.58 Sleep-Related Bruxism
- 780.58 Sleep-Related Rhythmic Movement Disorder
Pediatric Sleep Disorders: Prevalence

- Approximately 25% of all children experience some type of sleep problem.
- Yet, less than 25% of patients/parents with sleep problems seek physician help.
- Prevalence of various problems varies largely with age.
Pediatric Sleep Disorders: Infants

- Colic (1-4 months)
  - Melatonin metabolism?
- Conditioned Insomnia
- Adjustment Insomnia
Pediatric Sleep Disorders: School-Age

- Sleep Hygiene
- Adjustment issues
- Anxiety related sleep issues
- Obstructive Sleep Apnea
- Parasomnia
Pediatric Sleep Disorders: Adolescents

- Sleep Hygiene!!!
  - Diet
    - Caffeine
    - Chocolate
- Anxiety
- Obstructive Sleep apnea
- Narcolepsy
- Klein-Levin Syndrome
Evaluation of the Sleepy Child: History

- Chief Complaint = sleepy?
- Questionnaires / Surveys
- The Sleep Diary
  - Bedtime routine (Child AND parents)
  - Actual sleep duration
  - Sleep Environment
- Medications
- Diet
- Family History
- Other factors
The Sleepy Child ≠ The Sleepy Adult

<table>
<thead>
<tr>
<th>Adults</th>
<th>Children</th>
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<tbody>
<tr>
<td>Fatigue</td>
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<td>Behavioral issues</td>
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<td>Occupational Hazards</td>
<td>School</td>
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<td>Vigilance Tasks</td>
<td>Cognitive</td>
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<td>dysfunction</td>
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</table>
Evaluation of the Sleepy Child: History

**BEARS history**
- **B**edtime routine
  - Time, environment, distractions
- **E**xcessive Sleepiness
  - How much, actual sudden sleep, naps?
- **A**wakenings
  - Time, quantity, why?
- **R**egularity
  - Weekends/vacation better?
- **S**noring

Mindell JA, Owens JA. *A clinical Guide to Pediatric Sleep*, 2003
Evaluation of the Sleepy Child: History

- **Medications**
  - Allergy meds (Diphenhydramine)
  - Antidepressants
  - ADHD medication timing

- **Diet**
  - Caffeine
  - Chocolate / sugar

- **Family History**
  - Parasomnia
  - Insomnia/RLS
Evaluation of the Sleepy Child: Physical Exam

- Height / Weight
- BMI
- Observation of interaction with parent(s)
- Sleep Apnea / Obstruction risk
  - Craniofacial structure
  - Occlusion
  - Neck Size
  - Tonsil size / Mallampati Score
Figure 2 - Mallampati classification, modified by Samsoon & Young.
Role of Sleep Study

- Usually not required for majority of sleep disorders
  - Insomnia
  - Straight-forward Parasomnia
  - Circadian Rhythm Disorders

- Can be helpful in certain situations
  - Concerned about seizure
  - Movement disorders
    - May consider empiric treatment
  - Narcolepsy / Severe Hypersomnia
    - Multiple Sleep Latency Test (MSLT)
  - Still concerned about OSA
Narcolepsy, Seizures and Restless Leg Syndrome
Symptoms of Narcolepsy

- Excessive daytime sleepiness (EDS)
- Cataplexy
- Hypnagogic hallucinations
- Sleep paralysis
- Fragmented nocturnal sleep
- Other associated features

Adapted from AASM 2005 Slide Set: Narcolepsy
Excessive Daytime Sleepiness

- Sleep attacks on a background of chronic sleepiness or fatigue
- Frequent napping, usually refreshing
- Memory lapses and automatic behaviors
- Impaired attention / concentration
  - Decreased work performance
  - Increased drowsy driving crashes
- Visual disturbances

Adapted from AASM 2005 Slide Set: Narcolepsy
Excessive Daytime Sleepiness

Wilkinson Addition Test

Digit Symbol Substitution Test

Adapted from Mitler et al 1982

Adapted from AASM 2005 Slide Set: Narcolepsy
Cataplexy

- Muscle weakness triggered by emotions
  - Joking, laughter, excitement, anger
  - Brief duration, mostly bilateral
  - Sudden onset
- May affect any voluntary muscle
  - Knee / leg buckling, jaw sagging, head drooping, postural collapse
- Consciousness maintained at the start

Adapted from AASM 2005 Slide Set: Narcolepsy
Cataplexy

Adapted from AASM 2005 Slide Set: Narcolepsy
Cataplexy

Percentage of Patients

- Legs / knees
- Jaw
- Slurred speech
- Generalized (falling to ground)

Adapted from AASM 2005 Slide Set: Narcolepsy
Hallucinations

• Vivid hallucinations at sleep onset (hypnagogic) or awakening (hypnopompic)
• Auditory: sounds, music, someone talking to them
• Visual: colored circles, parts of objects
• Can be vividly realistic and anxiety provoking

Adapted from AASM 2005 Slide Set: Narcolepsy
Sleep Paralysis

• Sudden inability to move on falling asleep or on awakening
• Episodes are generally brief and benign, end spontaneously
• Can cause significant anxiety
• Associated with
  • Sleep deprivation
  • Narcolepsy
  • Obstructive sleep apnea

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Age of Onset

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Age of Onset

- Under-recognized / misdiagnosed
- Sleepiness may present as:
  - Learning disability
  - Attention deficit hyperactivity disorder
- Cataplexy may be mislabeled as psychogenic behavior
- May be secondary to other disorders

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Evaluation

- History
  - Sleepiness, cataplexy, other disassociated REM sleep features
- Polysomnography (PSG)
  - Exclude other causes for EDS (insufficient sleep, apnea)
  - Identify and treat associated conditions
- Multiple Sleep Latency Test (MSLT)
  - Objective sleepiness
  - Sleep onset REM periods (SOREMPs)
- CSF Hypocretin levels

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Symptom Prevalence

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Sleep Study Findings

- Short sleep latency
- Sleep onset REM period in 50% of narcoleptics
- Sleep fragmentation (REM and NREM)
  - Increased number of arousals
  - Increased stage 1 sleep
  - Low sleep efficiency
- Frequently associated with periodic limb movements

Adapted from AASM 2005 Slide Set: Narcolepsy
The MSLT is:
- A validated objective measure of the tendency to fall asleep
- Indicated as part of the evaluation of patients with suspected narcolepsy to confirm the diagnosis
- For 2 or more SOREMPs during MSLT:
  - Sensitivity was 0.79
  - Specificity was 0.98

From Arand et al 2005
Narcolepsy Treatment

- Excessive sleepiness
  - Scheduled naps

- Modafinil
- Sodium oxybate
- Amphetamine (meth- and dextro-)
- Methylphenidate
- Selegiline

From Arand et al 2005

Adapted from AASM 2005 Slide Set: Narcolepsy
Narcolepsy Treatment

- Cataplexy, sleep paralysis, halluc
- TCAs
  - Amitriptyline, clomipramine
  - Fluoxetine

From Arand et al 2005

Adapted from AASM 2005 Slide Set: Narcolepsy
Nocturnal Seizures

- Rarely witnessed, often poorly described
- Can be confused with parasomnias
- Profoundly disrupt sleep structure
  - Therefore disrupt daytime functioning

## Seizure Differential

### Table 1 Characteristics of Specific Sleep Disorders and Seizures

<table>
<thead>
<tr>
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<th>Seizure</th>
<th>Sleep Terrors</th>
<th>RLS</th>
<th>Narcolepsy</th>
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<tr>
<td>Incontinence</td>
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<td>-</td>
<td>-</td>
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<td>Tongue biting</td>
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<tr>
<td>Confusion</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tonic-clonic movmnts</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Drooling</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Amnesia</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Occur while awake</td>
<td>+</td>
<td>-</td>
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PLMS, periodic limb movements of sleep; RLS, restless legs syndrome

Seizure Onset by Sleep Stage

- Seizure onset primarily in Stage 1/2
- Rare during REM

Seizures - History

- Important to differentiate from parasomnias
- Speech often stereotypical in seizures
  - Vs. sleep talking=speech is random
- Occur predominantly in Stages 1/2
  - Vs. sleep walking=usually in SWS
- Atypical characteristics suggestive of seizure warrant full EEG evaluation
  - Nocturnal injury
  - Tongue or lip biting
  - Morning muscle soreness

Seizure & OSA

- In some individuals, OSA can
  - Provoke epileptic seizures or
  - Be the primary reason for intractability of epilepsy
- Seizures are likely triggered by hypoxia during an apneic event
- Severe hypersomnolence can result in sleep attacks with apparent sudden loss of consciousness

Seizures - Sleep Study

- If suspected, consider an extended montage EEG (more EEG leads)
- Look for spike and wave activity
  - Especially at transitions periods such as sleep onset
- REM usually spared
RLS Diagnosis in Children

• What are the 4 Essential criteria
  • A compelling urge to move the limbs
  • Symptoms worse/only at rest
  • Variable/temporary relief by activity
  • Symptoms worse in the evening /night
RLS Diagnosis in Children

• Supportive criteria
  • Sleep disturbance for age
  • Biological parent or sibling with RLS
  • Sleep study documenting periodic limb movement index ≥5/h
RLS Diagnosis

• History
  • Primarily a clinical diagnosis
  • 7 to 10% of population in US/ N Europe
  • Increases with age
  • Strong FH correlates with earlier age of onset (<45yo)

• Incidence
  • 2x more common in women
  • More common in whites than blacks
  • More common in iron deficient, pregnant and end-stage renal disease
RLS Aggravators

- Nicotine
- Caffeine
- SSRIs
- Metoclopramide
- Prochlorperazine maleate
- Dopamine antagonists
- Diphenhydramine
- Alcohol
RLS Diagnosis

• Supportive clinical features
  • In Children
    • Behavioral and mood difficulties
      • Including ADHD
    • Cognitive issues
    • Sleep difficulties
  • Adults and children
    • Sleep disturbance
    • Periodic leg movements
    • Response to dopaminergic therapy
    • Family history
    • Normal medical/physical evaluation
RLS Diagnosis

- Supplemental workup
  - Polysomnography
  - Iron profile
  - And/or neuropathy screen
RLS – Sleep Study

• Rhythmic or semi-rhythmic movements of the legs
• Found in 90% of RLS patients during sleep
• > 5 periodic limb movements/hour
RLS – Iron Studies

- Iron deficiency defined as:
  - Ferritin level $\leq 40$ ng/ml
  - acute-phase reactant
  - may misrepresent the true iron stores, so the transferrin saturation determined along with it
- Transferrin saturation percentage $\leq 16\%$
**RLS Treatment**

- Behavioral techniques - *1st line in peds*
- Sleep Hygiene - *1st line in peds*
- Iron – very low or iron deficiency
  - Ferritin below 40
- Dopaminergic agents
  - Pramipexole - Rotigotine
  - Ropinirole
  - Levodopa - augmentation
- Antiepileptics – gabapentin, pregabalin, carbemazepine
- Opiates – oxycodone, tramadol
Circadian Rhythm Disorders
Incidence of Circadian Rhythm Disorders

- NSF- 1/15 children in age range of 5-13 years have CRD
- 200,000 children in US
- Adolescents reported prevalence up to 16% with Delayed Sleep Phase Syndrome
Internal Clock in Children

- Birth- Infant sleep pattern irregular
- 4-6 Months- Sleeping more night
- By 18 months, most children sleep all night
- Regular adult sleep wake cycle usually established by age 5
Physiology of Circadian Rhythm

- The suprachiasmatic nucleus (SCN) = pacemaker
- Light is the strongest influence on the sleep/wake cycle
- Melatonin secretion signals sleep period
Normal Adolescent Sleep Changes

- Adolescents have a normal shift of sleep time by 2 hours
- Delayed melatonin secretion with puberty
Types of Pediatric Circadian Rhythm Disorders

- Free Running or non-24 hours type
- Irregular Sleep Wake Pattern
- Advanced Sleep Phase Syndrome
- Delayed Sleep Phase Syndrome
Advanced Sleep Phase Syndrome

- Sleep and wake very early 6pm- 3am
- May be genetic
- 1% Elderly
- Young Children- the early awakening is a problem for parents
General Treatment of CRDs

- Firm sleep/wake schedule- fixed AM arising time most important
- Avoid weekend variation
- Sleep Hygiene- caffeine, computer, cell phones, lights, TV
Delayed Sleep Phase - Night Owls

- Delay in sleep time by 2 or more hours
- Difficulty arising in the morning
- Sleeping in very late on weekends
- Results in sleep deprivation during the week
- Occurs in 7-16% of Teens
Manifestations of DSPS

- Sleepiness
- Insomnia - difficulty going to sleep
- School dysfunction
- Auto accidents due to sleepiness
- Family conflict
Factors contributing to DSPS

- Evening light exposure - suppresses melatonin secretion
  - Computer screens
  - Video Games
  - Bright overhead lighting
Treatment of DSPS

- Sleep Hygiene
- Firm Sleep Schedule
- Melatonin
- Chronotherapy
Sleep Hygiene
Sleep Hygiene

- Environmental factors contributing to poor sleep in children
  - Infant – teenage
- Impact of poor sleep hygiene
- Ways to improve sleep hygiene
Sleep Hygiene: General

Comfortable Sleep environment
- Correct temperature
- Quiet
- Dark
Cheerios & Pampers Advice

Age 1-2 years
- Put child to sleep when drowsy, but not already asleep

Pre-school age
- Establish a routine
Limit-Setting Sleep Disorder

- Behavioral insomnia of childhood
  - Bedtime stalling and repeated demands

Treatment

- Consistency in routine and limit setting
  - Day AND night time
  - Time warning(s) (bedtime in 30, 10, 5 minutes)
- Positive reinforcement
  - Charts
  - Rewards
How many hours of sleep does the average teenager need?

Older school-aged children and teens need on average about 9.25 hours of sleep a day.

Carskadon MA et al. Sleep 1980
How many hours of sleep does the average teenager get?

- Sixth-graders sleep an average of 8.4 hrs on school nights
- 12th-graders sleep on average 6.9 hrs/night
  - 2 hours less sleep than recommended
- Only 20 percent of teens get 9 hours of sleep on school nights

Sleep in America Poll 2006
Teens and Electronics

97% of children and teens have at least one electronic item in their bedroom
  – television, computer, phone or music player

Adolescents with ≥4 such items in their bedrooms are much less likely than their peers to get a sufficient amount of sleep
  – Sleep in America Poll 2006
Cell phones

- 4/5 teens carry a cell phone
- 40% increase from percent of teens in 2004
  - wireless trade association CTIA and Harris Interactive 2008

- On average kids get their first cell phone
  between 10-11 yo

- Nearly half of kids 8-12 years old own cell phones in the U.S
  - Nielsen report 2008

- 42% of teens surveyed say they can text blindfolded
Cell phone use and sleep

- Prospective study of 1,600 13-15 yo
- 60% talk or text message after lights out
- A year later, teens who used their cell phone more than once a week after lights-out were 5x more likely to say they felt tired
- The later teens stayed awake with their phones, the more tired they were

– Van Den Bulck Sleep 2007
Computers

- 72% of teenagers have own desktop computer
- 25% of teenagers have own laptop computer
- Teens spend an average of 2.9 hours/day on-line
  - CBS news survey 2006
- 55% of households have rules about how much time children/teens are allowed to spend on-line
  - Pew Internet and American Life Project Parent and Teen Survey 2006
Computers

- 22% of school age children admit they IM while their parents think they are asleep
  - i-safe America poll 2007

- 51% of kids check their social network daily
  - 23% of parents think their kids check their networks daily

- 22% of teenagers check their social networks more than 10 times/day
  - 4% of parents think their kids check their social networks more than 10 times/day
  - Common Sense Media poll 2009
Television

- 43% of school aged children, 33% of preschool children and 20% of infants and toddlers have TVs in their bedrooms

- Children with TVs in their bedrooms
  - Go to sleep 20 minutes later
  - Sleep 40 minutes less per night
  - Loss of 2 hours sleep every week
    - Sleep in America Survey 2006

- 58% of households have limits on number of hours of TV viewing allowed
  - Pew Internet and American Life Project Parent and Teen Survey 2006
Caffeine

- 76% of children are getting caffeine from some source on a daily basis
  - Journal of the American Dietetics Association 2004

- 31% of teens consume at least 2 caffeinated beverages/day
  - Sleep in America Poll 2006

- 31% of US teens drink energy drinks on a regular basis
  - Simmons research poll 2006
Effects of Sleep Deprivation

- School performance
- Mood
- Obesity
- Automobile accidents
Recommendations: Teens

- Regular bedtime and sleep schedule
- Relaxing bedtime routine
  - Reading, music
- Remove distractions from bedroom
  - TV, Phone, computer
  - Use parental controls, check phone logs
- Avoid caffeine
  - Especially after lunch
**Recommendations**  
*Parental Awareness*

- Most teens know they're not getting enough sleep  
  - Half of teenagers admit they get less sleep than they need to be at their best  
  - 51 percent say they feel too tired or sleepy during the day  
- 90 percent of parents believe their adolescents are getting enough sleep on school nights  
  - Sleep in America Poll 2006
Parental Awareness: Sleep Needs

<table>
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<tr>
<th>Age</th>
<th>Sleep Needs</th>
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<td>Newborns (1-2 months)</td>
<td>10.5-18 hours</td>
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<tr>
<td>Infants (3-11 months)</td>
<td>9-12 hours during night and 30-minute to two-hour naps, one to four times a day</td>
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<tr>
<td>Toddlers (1-3 years)</td>
<td>12-14 hours</td>
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<td>Preschoolers (3-5 years)</td>
<td>11-13 hours</td>
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<td>School-aged Children (5-12 years)</td>
<td>10-11 hours</td>
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<td>Teens (11-17)</td>
<td>8.5-9.25 hours</td>
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<td>Adults</td>
<td>7-9 hours</td>
</tr>
<tr>
<td>Older Adults</td>
<td>7-9 hours</td>
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</tbody>
</table>

www.sleepfoundation.org
Summary

- Sleep hygiene issues are by far the most common pediatric sleep problems.
- Sleepiness is not the most common way children with sleep disorders present.
- The sleep history and sleep diary are the most useful tools to make a diagnosis.
- The physical exam is of limited usefulness.
- PSG is only used in a minority of cases.
Summary

- Narcolepsy can occur in children and is characterized by:
  - Excessive daytime sleepiness (EDS)
  - Cataplexy
  - Hypnagogic hallucinations
  - Sleep paralysis
- PSG with MSLT is the primary tool for diagnosis
Summary

• Seizures must be differentiated from parasomnias
  • Can be increased with concomitant OSA
  • Extended montage EEG with the PSG may pick up nocturnal seizures
  • Tend to occur in NREM, rare in SWS and REM
  • Full Neurologic evaluation with Extended EEG may be required
Summary

• RLS is characterized by 4 essential features:
  • An urge to move, usually associated with paresthesias
  • Onset or exacerbation of symptoms at rest
  • Relief of symptoms with movement
  • Symptoms manifesting in a circadian pattern
Summary

• RLS in children – alternate criteria:
  • Four essential adult criteria plus two supportive criteria
  • Supportive criteria
    • Sleep disturbance for age (including daytime sleepiness)
    • Biological parent or sibling with RLS
    • Sleep study documenting periodic limb movement index ≥5/h
Summary

- Circadian Rhythm Disorders are common in children and adolescents
- Even if SDB present, look for other sleep disorders
- In Teens- be especially aware of DSPS and the possibility of sleep deprivation
Summary

- Awareness of problem/sleep needs of children
- Set a good example
  - Most adults are sleep deprived as well!
- Consistency important
- Sleep conducive environment
- Control use of electronics and caffeine
- Legislation
  - Driving restrictions for teens
  - School start times
Thank You

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Practice Change

Recognize the need to extend the number of hours of sleep for most children