An Update on AASM Scoring Rules

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Objectives

• Be able to discuss new AASM scoring changes
• Differentiate between adult, pediatric and infant scoring rules
• Apply new rules appropriately

AASM Scoring Changes
Effective October 1, 2016

• New technical specifications for Movement Rules
• New rules for scoring PLMS
• Revision of scoring of bruxism
• New rule for staging when 3 stages are present in one epoch
• Clarification on scoring arousals preceding transition to wake
• New Pediatric and Infant stage scoring rules and respiratory clarifications
**Scoring Stage 2 Clarifications**

- Epochs following stage N3 are scored stage N2 if not meet criteria for stage N3, W or REM
- End stage 2 if transition to stage W, N3, REM or arousal to LAMF

**Stage 2 with Body Movement**

A major body movement followed by a slow eye movement is stage 1, otherwise stage 2

**Scoring Stage 3 Clarifications**

- K complexes are considered slow waves if they meet definition of SW activity
- Pathological wave forms that meet SW activity such as those generated by metabolic encephalopathies and epileptic activity are not considered slow wave activity of sleep
Scoring Stage REM Clarification

• Absence of REMs if all the following are present:
  – EEG shows LAMF without K complex or sleep spindles
  – Chin EMG low at stage R level
  – No intervening arousal
  – SEMs after arousal or stage W are absent
• After definite stage REM, continue to score stage REM in absence of REMs if all the following met:
  – EEG shows LAMF without K complex or sleep spindles
  – Chin EMG is low at stage R level for majority of epoch
  – No intervening arousal

Stage R rules take precedence over stage N2 rules if epoch meets stage REM criteria.
Scoring with ≥3 Stages in One Epoch

- If ≥3 stages in a single epoch do not include wake, assign the predominant sleep stage
- If ≥3 stages occur in a single epoch and include wake
  - Score wake if greater than 50% of epoch is wake
  - Score the predominant sleep stage (N1, N2, N3, or R) if wake is <50% of epoch

Schematic of 3 Stages in One Epoch


Sleep Stage Scoring in Children ≥2 months post-term

- Stages W, N1, N2, N3, R, N (NREM)
- Score stage N when
  - all epochs of NREM have no sleep spindles, K complexes or high amplitude 0.5-2Hz slow waves
- Score stage N2 and N when
  - some epochs have spindles or K complexes score as Stage 2. If other NREM epochs have no SWS in more than 20% of epoch, score Stage N.
- Score stage N2, N3 and N when
  - if some epochs have ≥20% SWS, score Stage N3. If other NREM epochs have no spindles or K complexes, score as Stage N
- Score stage N1, N2, N3 and R when
  - NREM has spindles, K complexes and SWS then score NREM in infant as Stage N1, N2 or N3 as in older child or adult
**Scoring Stage W in Children**

- contains either or both
  - Age appropriate posterior dominant rhythm (slower in children) over occipital lobe (alpha rhythm with EC)
  - Findings consistent with Stage W
    - Eye blinks
    - Reading eye movements
    - Rapid eye movements with normal or high chin EMG

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**Scoring Stage N1 in Children**

- If PDR present, Score Stage N1 if PDR is attenuated or replaced by low amp mixed frequency (LAMF) >50% of epoch
- If no PDR, score Stage N1 beginning with the earliest of ANY of the following:
  - 4-7 Hz with slowing of background by ≥1 Hz from wake
  - Slow eye movements
  - Vertex sharp waves
  - Hypnogogic hypersynchrony (bursts high amp 3-4.5 Hz)
  - Diffuse or occipital dominant high amp rhythmic 3-5 Hz

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**Score Stage N2, N3 and REM in Children Same as Adult**
Infant Scoring

- 0-2 mos post term (37-48 wks conceptual age)
- Stages:
  - Stage W
  - Stage N (NREM)
  - Stage R (REM),
  - Stage T (Transitional)
- Stage T scored if characteristics of Stage R and N
- Score based on behavior, regularity of respiration EEG and EOG patterns
- Regularity or irregularity of respiration most reliable for scoring
- First sleep epoch often REM
- Trace alternant pattern common

Characteristics of Infant Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Behavior</th>
<th>Respiration</th>
<th>EEG</th>
<th>EOG</th>
<th>Chin EMG</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Eyes Open</td>
<td>Irregular</td>
<td>Low voltage irregular or mixed</td>
<td>REMs, Blink present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feeding Crying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Eyes closed</td>
<td>Regular</td>
<td>Trace alternate</td>
<td>High volt slow mixed voltage spindles</td>
<td>Present</td>
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<td></td>
<td>Reduce mot. vs.</td>
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<tr>
<td></td>
<td>wake Sucking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Eyes closed</td>
<td>Irregular</td>
<td>Low voltage irregular or mixed</td>
<td>EC, REMs</td>
<td>Low, transient mot</td>
</tr>
<tr>
<td></td>
<td>Small movements</td>
<td></td>
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</tr>
</tbody>
</table>

Stage W in Infant
Stage N in Infant

Stage N in Infant
Trace Alternant

EEG in Infant

Scoring Stage R in Infants

- Stage R has 4 or more of the following including irregular respiration and REM:
  - Low chin EMG
  - Eyes closed and at least one REM
  - Irregular respiration
  - Mouthing, sucking, twitches
  - No sleep spindles
- Score R in contiguous epochs without rems if all are present:
  - EEG is mixed frequency, no spindles, no trace alternate
  - Chin EMG is low
  - No intervening arousal

Stage R in Infants

Scoring Stage T

- Score as stage N, R or W if only one characteristic is discordant for state
- Score stage T if epoch contains either
  - 3 NREM + 2 REM characteristics
  - 2 NREM + 3 REM characteristics
Stage T (transitional)

Anterior Tibialis Electrode Placements

Recommended

Flexor Digitorium

Optional

Extensor Digitorium

Optional
Scoring PLMS

- Individual LM duration is between 0.5-10 sec
- First two PLMS are counted as one because <5 sec separation
- Period length to the second LM is measured from onset of the first LM in group considered to be a single LM.


Association of PLMS and Arousal

Arousals and PLMs < 10 sec Apart

When PLMs occur <10 sec apart and each is associated with an arousal, only the first arousal should be scored (assuming it is preceded by at least 10 sec of sleep). Both LMs are scored but only one arousal.
LMs and Intervening Wake

- When a wake period lasting <90 sec. separates a series of LMs, the LMs preceding wake can be included with the subsequent LMs as part of a series. (recommended)

Rhythmic Movement Disorder

- Time synchronized-video PSG for diagnosis (recommended)
- Paraspinal muscles electrode placement (optional)

REM Sleep Behavior Disorder

- Must have time synchronized audio-equipped video PSG for complex motor activity and vocalizations (recommended)
- Diagnosis of RBD requires either:
  - Demonstration of a behavioral or vocal episode
  - Characteristic clinical history of dream enactment and REM sleep without atonia
- PSG shows sustained muscle activity in REM and/or excessive transient muscle activity in REM
Masseter Electrode Placement for Detecting Bruxism
Optional- can use chin EMG


Arousals During Wake

• Arousals occurring during an awake epoch between "lights out" and "lights on" should be scored and used for computation of the arousal index.
• The 10 seconds of stable sleep required prior to scoring an arousal may begin in the preceding epoch, including a preceding epoch that is scored as stage W. (recommended)
Two Arousals during Wake

Arousal Preceding Wake
• An arousal may still be scored if it immediately precedes a transition to stage W. That is, both the arousal and transition to wake are scored (recommended).

Respiratory Sensors (Adults & Peds)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recommended</th>
<th>Alternate if Rec Fails</th>
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</thead>
<tbody>
<tr>
<td>Apnea</td>
<td>oronasal thermal sensor</td>
<td>Nasal pressure transducer</td>
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<tr>
<td></td>
<td></td>
<td>RIPsum</td>
</tr>
<tr>
<td>Hypopnea</td>
<td>Nasal pressure transducer</td>
<td>Oronasal thermistor</td>
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<td></td>
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<td>RIPflow</td>
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<tr>
<td></td>
<td></td>
<td>RIPflow</td>
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<td></td>
<td></td>
<td>2 thoracoabdominal RIP belts</td>
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<td>NFI during PAP</td>
<td>PAP device flow signal</td>
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<tr>
<td>Respiratory Effort</td>
<td>esophageal manometry</td>
<td>2 thoracoabdominal RIP belts</td>
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<tr>
<td>Snoring</td>
<td>Microphone Piezoelectric sensor</td>
<td>Nasal pressure transducer</td>
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<tr>
<td>Hypoventilation</td>
<td>Optional</td>
<td>Arterial PCO2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transcutaneous PCO2</td>
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<tr>
<td></td>
<td></td>
<td>End tidal PCO2</td>
</tr>
<tr>
<td>Hypoventilation w/CPAP</td>
<td>Optional</td>
<td>Arterial PCO2</td>
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<tr>
<td></td>
<td></td>
<td>Transcutaneous PCO2</td>
</tr>
</tbody>
</table>
Respiratory Scoring Clarifications

• If a portion of a respiratory event that would meet criteria for hypopnea meets criteria for apnea, score apnea
• If apnea or hypopnea begins or ends in an epoch scored sleep then event is scored
• If apnea or hypopnea occurs entirely during a wake epoch, it is not scored

Apneas and Hypopneas that Cross Epochs
Score apneas and hypopneas during wake if preceding epoch is sleep
Apnea During Wake

Scoring of Hypopneas in Adults
• Drop of >30% from pre-event baseline in nasal pressure excursion or (PAP device flow) or alternative hypopnea sensor
• Duration of drop is >10 sec
• There is a >3% oxygen desaturation from pre-event baseline or event is associated with an arousal (recommended)
• There is a >4% oxygen desaturation from pre-event baseline (acceptable)
• Scoring hypopneas as central or obstructive is optional

CHYENE STOKES RESPIRATION
Definition requires both:
• ≥3 consecutive central apneas and/or central hypopneas separated by crescendo and decrescendo breathing and cycle length ≥ 40 sec
• ≥5 central apneas and/or central hypopneas per hour of sleep with crescendo/decrescendo breathing in ≥2 hrs
CHEYNE STOKES RESPIRATION
CLARIFICATION
• Individual central apneas in a run of CSR are scored
• Cycle length is from beginning of central apnea to the end of the crescendo/decrescendo phase (or start of next central apnea)

Scoring Obstructive Apnea in Children
(< 18 y.o. but ≥13 can use adult criteria)
• Signal drop ≥90% in oronasal thermal sensor from pre-event baseline
• Lasts at least the duration of 2 breaths during baseline breathing AND is associated with respiratory effort throughout entire period of absent airflow

Scoring Central Apnea in Children and Infants
Airflow Signal drop ≥90% from baseline and absent effort throughout event AND one of the following
• Event lasts ≥20 sec
• Lasts at least the duration of 2 breaths during baseline breathing AND is associated with an arousal or ≥3% arterial oxygen desaturation
• Event lasts at least the duration of 2 breaths during baseline breathing and is associated with a decrease in HR <50 bpm for ≥ 5 sec or <60 bpm for 15 sec (infants under 1 yr of age)
Scoring Mixed Apnea in Children

• Mixed apnea is at least the duration of 2 breaths during baseline breathing AND is associated with absent respiratory effort during part of the event and presence of inspiratory effort in another portion regardless of which portion came first.

Scoring Hypopneas in Children

Score an hypopnea if ALL of the following are met:
• Peak signal drop by ≥30% of pre-event baseline using nasal pressure, PAP device or alternative
• The ≥30% drop lasts ≥2 breaths
• There is a >3% oxygen desaturation from pre-event baseline or event is associated with an arousal

Periodic Breathing Clarification

• ≥3 episodes of central pauses in respiration lasting > 3 sec separated by ≤ 20 sec of normal breathing
• Individual central apneas are also scored