Scoring Definitions for Sleep Related Events

- Audience:All personnel in the Sleep Disorder Center.Purpose:Standard definitions for all sleep related-events assure consistency and accuracy
of scoring and interpretation of sleep recordings.
- **Policy:** Standard definitions for all sleep-related events will be used. These definitions will conform to Clinical Practice Parameters set by the AASM where they exist and to latest version of The AASM Manual for the Scoring of Sleep and Associated Events. All definitions used will be approved by the Medical Director and all individuals scoring records will use these definitions.

The following definitions of sleep related-events will be used by the University of Texas Medical Branch Sleep Disorder Center:

Scoring of respiratory events:

Respiratory events will be scored according to the current AASM Respiratory Rules described in the latest version of The AASM Manual for the Scoring of Sleep and Associated Events.

The following channels will be used in scoring respiration:

- Nasal air pressure transducer or PAP device flow signal
 - Nasal air pressure transducer or PAP device flow signal will be used for the identification of hypopneas and as an alternative sensor for the identification of apneas
- Oronasal thermal sensor
 - Oronasal thermal sensor will be used for the identification of apneas and as an alternative sensor for the identification of hypopneas
- Chest respiratory inductance plethysmography (or PVDF belt)
 - Chest respiratory inductance plethysmography (or PVDF belt) will be used for the identification of effort and as an alternative sensor for the identification of hypopneas (in combination with Abdomen RIP or PVDF belt correspondingly)
- Abdomen respiratory inductance plethysmography (or PVDF belt)
 - Abdomen respiratory inductance plethysmography (or PVDF belt) will be used for the identification of effort and as an alternative sensor for the identification of hypopneas (in combination with Chest RIP or PVDF belt correspondingly)

- SaO2
 - SaO2 will be used to monitor O2 saturation and for the scoring of hypopneas.

Duration of a respiratory event:

Duration of a respiratory event will be determined

• from the nadir preceding the first clearly reduced in amplitude breath to the beginning of the first breath approximating the baseline breathing amplitude.

If the baseline breathing amplitude is difficult to determine, the termination of the event will be identified

- at the beginning of a clear and sustained increase in breathing amplitude,
 - or
- at the event-associated resaturation of at least 2%.

Scoring of apneas:

Apnea will be scored when the following criteria will be met:

- There is a reduction in the thermal sensor signal amplitude (or those of the alternative sensor or PAP flow signal) by ≥90% of baseline
- The duration of the event is at least 10 seconds.
- At least 10 seconds of the event duration meets the amplitude reduction criteria for apnea
- Desaturation is not required for the identification of apnea

Apnea will be classified as <u>obstructive</u> if associated with present inspiratory effort during the entire period of flow sensor signal amplitude reduction.

Apnea will be classified as <u>central</u> if associated with absent inspiratory effort during the entire period of absent airflow.

Apnea will be classified as <u>mixed</u> if associated with absent inspiratory effort in the beginning of the event, followed by resumption of effort in the latter portion of the event.

Scoring of hypopneas:

Hypopnea will be scored according to latest version of the AASM Scoring Manual when the following criteria will be met:

- The nasal pressure signal excursions (or those of the alternative hypopneas sensor) drop by $\ge 30\%$ of baseline
- The duration of the event is at least 10 seconds.
- At least 90% or 9 seconds of the event duration meets the amplitude reduction criteria for hypopnea
- At least 4% desaturations from the pre-event baseline will be required for the identification of hypopneas

Scoring of respiratory effort-related arousals:

Respiratory effort-related arousal criteria:

- increasing respiratory effort determined by respiratory inductance plethysmography or
- flattening of the nasal pressure waveform (nasal pressure or PAP flow)
- with the duration of the event of at least 10 seconds
- leading to an arousal from sleep
- and the event does not meet criteria for apnea or hypopnea

Scoring of Cheyne Stokes Breathing:

Cheyne Stokes Breathing will be scored when both of the following criteria are met:

- 1. a. there are at least 3 consecutive central apneas or hypopneas
 - b. separated by crescendo-decrescendo change in breathing amplitude
 - c. with >40 seconds duration of a cycle
- 2. at least five or more central apneas per hour of sleep associated with this pattern in at least 2 hours of recording.

Scoring of hypoventilation (adults):

Hypoventilation will be scored when:

- PaCO2 (measured by end-tidal CO2 or transcutaneous CO2) in sleep is 10 mmHg higher than the level recorded with the patient awake and in supine position and exceeds 50 mmHg for at least 10 minutes
- PaCO2 exceeds 55 mgHg for at least 10 minutes
- Oxygen desaturation is not enough to score hypoventilation

Scoring of Periodic Limb Movement of Sleep (PLMS):

The following channels with corresponding sensitivity and filters settings will be used in scoring PLMS: left and right leg channels: EEG events and Respiratory events will be considered in scoring leg movements

Leg movements will be characterized by the latest version of the AASM scoring manual criteria.

The following criteria will be used for scoring of leg movements:

Leg Movement definition:

Leg Movement:

- a burst of anterior tibialis muscle activity
- with a duration of 0.5 10 seconds
- and an amplitude 8 µv increase above resting EMG

Timing:

- Beginning of 8 µv EMG increase
- Ending at the start of a period lasting at least 0.5 seconds during which the EMG does not exceed 2 μ v above the resting EMG

Leg Movements in 2 different legs separated by less than 5 seconds (onset – onset) are considered ONE movement

The following criteria will be used for scoring PLMS:

PLMS - a sequence of 4 or more leg movements (Leg Movements – defined as a burst of anterior tibialis muscle activity with a duration of 0.5-10 seconds with an amplitude 8 μ v increase above resting EMG) and separated by at least 5 sec and not more than 90 seconds from onset to onset of Leg Movements. *Note:*

- Leg Movements are not scored during an apnea or hypopnea or RERA if there is less than 0.5 seconds BEFORE or AFTER an apnea or hypopnea or RERA
- Leg Movement is considered associated with an arousal if the arousal starts <0.5 seconds from the BEGINNING or END of a Leg Movement.

OPTIONAL Scoring of Alternating Leg Muscle Activation (ALMA):

ALMA will be scored when:

There are EMG bursts from one leg and then from the other and

- There must be a series of at least 4 muscle bursts
- The frequency of bursts must be at least 0.5 Hz (the maximum interval between bursts should be not more than 2 sec)
- The frequency of bursts must be not more than 3 Hz (the minimum interval between bursts should be not less than 0.3 sec)

OPTIONAL Scoring of Hypnagogic Foot Tremor (HFT):

HFT will be scored when:

• There must be a series of at least 4 muscle bursts

- The frequency of bursts must be at least 0.3 Hz (the maximum interval between bursts should be not more than 3 sec)
- The frequency of bursts must be not more than 4 Hz (the minimum interval between bursts should be not less than 0.25 sec)

OPTIONAL Scoring of Excessive Fragmentary Myoclonus (EFM):

EFM will be scored when:

- There are EMG bursts with usual maximum duration of EMG burst of 150 msec
- With a rate of at least 5 bursts per minute
- Lasting for at least 20 minutes in NREM

Scoring of bruxism:

A. Scoring from chin EMG

- Bruxism may consist of brief (phasic) or sustained (tonic) chin EMG activity with the amplitude that is at least twice the amplitude of background EMG.
 - Phasic chin EMG activity is scored as bruxism if they are at least 3 elevations occuring in a regular sequence and each burst is 0.25 2 seconds in duration.
 - Tonic chin EMG activity is scored as bruxism if the duration of EMG elevation is more than 2 seconds.
 - Before a new episode of bruxism can be scored, there must be at least 3 seconds of background chin EMG amplitude.
- B. Scoring from audio recording in combination with polysomnography
 - Bruxism may be scored by recorded during polysomnography sound together when more than 2 audible tooth grinding episodes occur per night. Note: Epilepsy should be excluded.

Scoring of REM Sleep Behavior Disorder (RBD):

RBD will be scored when there is:

• Sustained muscle activity in the chin EMG in REM sleep with more than 50% of the epoch having a chin EMG amplitude greater than the minimum amplitude in NREM

or

• Excessive transient muscle activity (phasic activity) in REM sleep, when 50% or more of the 3 seconds mini-epochs episodes contain bursts of transient muscle activity with the amplitude at least 4 times higher than the background EMG amplitude and the duration of EMG bursts is 0.1 – 5.0 seconds.

Scoring of Rhythmic Movement Disorder:

Rhythmic Movement Disorder will be scored when:

- There is a series of at least 4 movements
- With the amplitude of an individual burst at least 2 times background EMG activity
- And the frequency of EMG bursts is between 0.5 Hz and 2 Hz

Scoring of EKG:

EKG will be analyzed from the modified EKG channel II.

The following cardiac events will be documented:

• The average heart rate during NREM, and the average heart rate during REM will be documented.

Note:

- The norm is between 60-100 bpm, with the HR in REM tending to be slightly faster than in NREM.
- If the HR slows down or speeds up during respiratory events it should be documented.
- A decrease of 20 bpm is considered significant and should be documented.
- Highest heart rate during sleep.
- Highest heart rate during recording

The occurrence of following arrhythmias should be documented (yes/no)

- Bradycardia (sustained more than 30 seconds of a stable rhythm heart rate less than 40 bpm for ages 6 years through adult) with the lowest heart rate observed reported
- Asystole (cardiac pauses greater than 3 seconds for ages 6 years through adult) with the longest observed pause reported
- Sinus tachycardia during sleep (sustained more than 30 seconds of a stable rhythm sinus heart rate of greater than 90 beats per minute for adults) with the highest rate observed reported
- Narrow complex tachycardia (at least 3 consecutive beats at a rate > 100 bpm AND QRS duration ≤ 120 msec) with the highest rate observed reported
- Wide complex tachycardia (at least 3 consecutive beats at a rate > 100 bpm AND QRS duration ≥ 120 msec) with the highest rate observed reported

• Atrial fibrillation (irregularly irregular rhythm associated with replacement of consistent P waves by rapid oscillations that vary in size, shape, and timing)

The presence, frequency and type (i.e., unifocal vs. multifocal) of PVCs should be documented.

Presence of bigeminy, trigeminy, couplets, PAC, or any other observed EKG abnormality should be documented along with the page number when appropriate.

The monitoring technician or scoring technician will prepare the printouts with noted EKG abnormalities.

Scoring Summary:

The following parameters will be reported by the University of Texas Medical Branch Sleep Disorder Center:

- TST-total sleep time is the total time of all sleep stages
- Total recording time is time from lights out until end of the recording ("lights on")
- Sleep latency time in minutes from lights out to the first epoch of any stage of sleep
- Sleep efficiency- total sleep time divided by total recording time and X 100%
- Time in each stage (in minutes).
 - % Stage N1- total minutes of stage N1 divided by total sleep time and X 100%
 - % Stage N2- total minutes of stage N2 divided by total sleep time and X 100%.
 - % Stage N3- total minutes of stage N3 divided by total sleep time and X 100%.
 - % Stage R- total minutes of stage R divided by total sleep time and X 100%.

- Wake after sleep onset (WASO), equal to total recording time minus sleep latency minus total sleep time.
- The number of arousals
 - ArI the arousal index total number of arousals related to respiratory events divided by total sleep time in hours (or divided by total sleep time in minutes and X60).
- Numbers of obstructive apneas, central apneas, mixed apneas and hypopneas separately.
- Obstructive and central hypopneas will not be differentiated during scoring at the University of Texas Medical Branch Sleep Disorder Center
- RERA will not be scored and\reported (unless requested by interpreting physician)
- Number of apneas and hypopneas.
- Apnea index: sum of obstructive apneas, central apneas and mixed apneas divided by total sleep time in hours (or divided by total sleep time in minutes and X60)
- AHI total number of apneas and hypopneas divided by total sleep time in hours (or divided by total sleep time in minutes and X60)
- Lowest oxygen saturation in sleep.
- Mean value of the oxygen saturation in sleep.
- Time at different levels of saturation.
- Cheyne Stokes breathing pattern Identified and reported by scoring technologist with the number of Cheyne-Stokes breathing events or with the pattern duration in minutes or as a percentage of TST
- Number of PLM in sleep
- Number of PLM in sleep with arousals
- PLM index number of periodic limb movements divided by total sleep time in hours (or divided by total sleep time in minutes and X60)

- PLM arousal index total number of periodic limb movements associated with arousal divided by total sleep time in hours (or divided by total sleep time in minutes and X60)
- Average heart rate during sleep
- Highest heart rate during sleep
- Highest heart rate during recording
- Bradicardia with lowest heart rate.
- Asystole with the longest pause duration
- Sinus tachycardia with the highest rate.
- Narrow complex and/or wide complex tachycardia with the highest rate
- Atrial fibrillation or flatter
- Presence of other arrhythmias (PAC, PVC, PJC and AV blocks, etc.)

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