

Sleep Diagnostic Dilemmas and PSG Puzzlers

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Conflict of Interest Disclosure

- Aneesa Das, MD
 - Uptodate Royalties
- David Schulman, MD
 - Uptodate Royalties

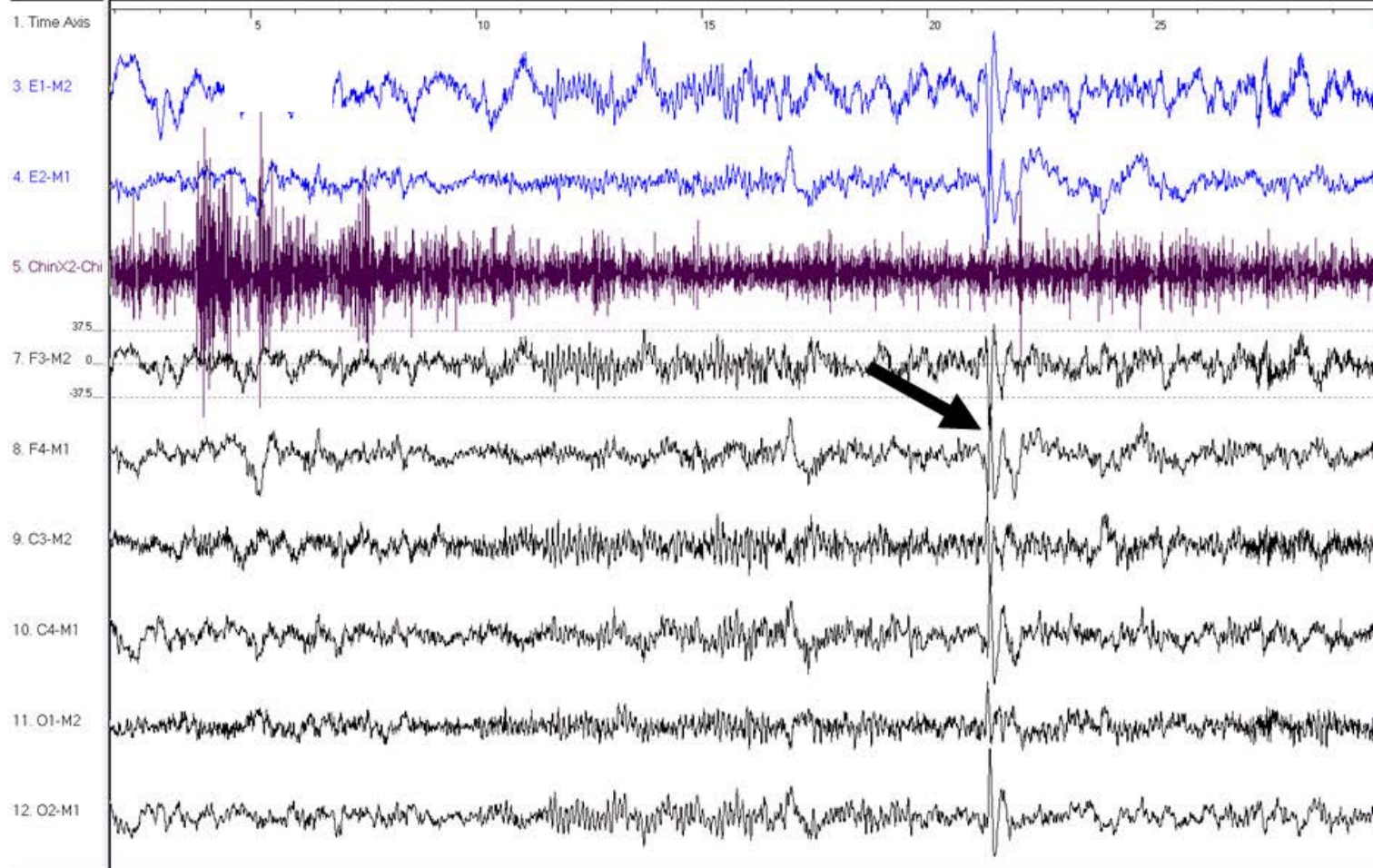
- An 86 year old woman is being evaluated by a neurologist for progressive cognitive and behavioral decline
- Her neuropsychiatric and extended mental status examination is consistent with Alzheimer's disease
- Recently started on memantine and galantamine

A Das, T Afaq. American Thoracic Society. Sleep Fragments.
2011

- Subsequently referred to sleep clinic for evaluation of daytime sleepiness, snoring and witnessed apneas
- Goes to bed around midnight and gets up by 8 am
- Denies excessive movements or arousals during sleep
- Overall AHI is 21.1 with oxygen nadir 71%

Thailand

Bangkok | 10-12 April

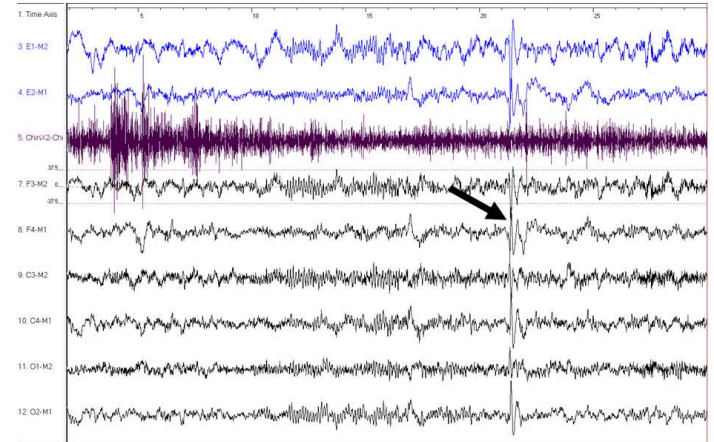


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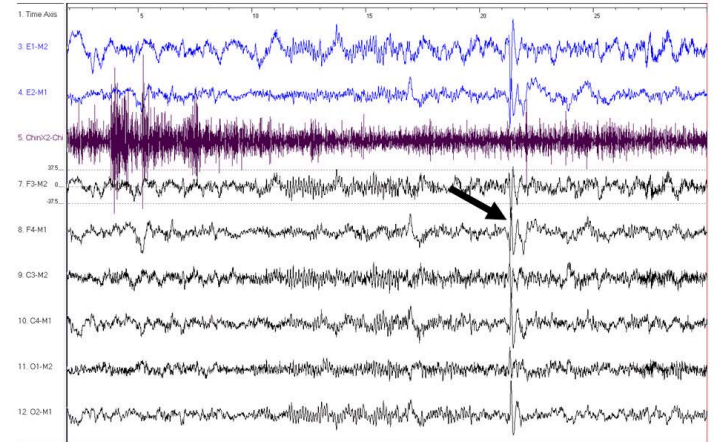
What is the waveform shown by the arrow?

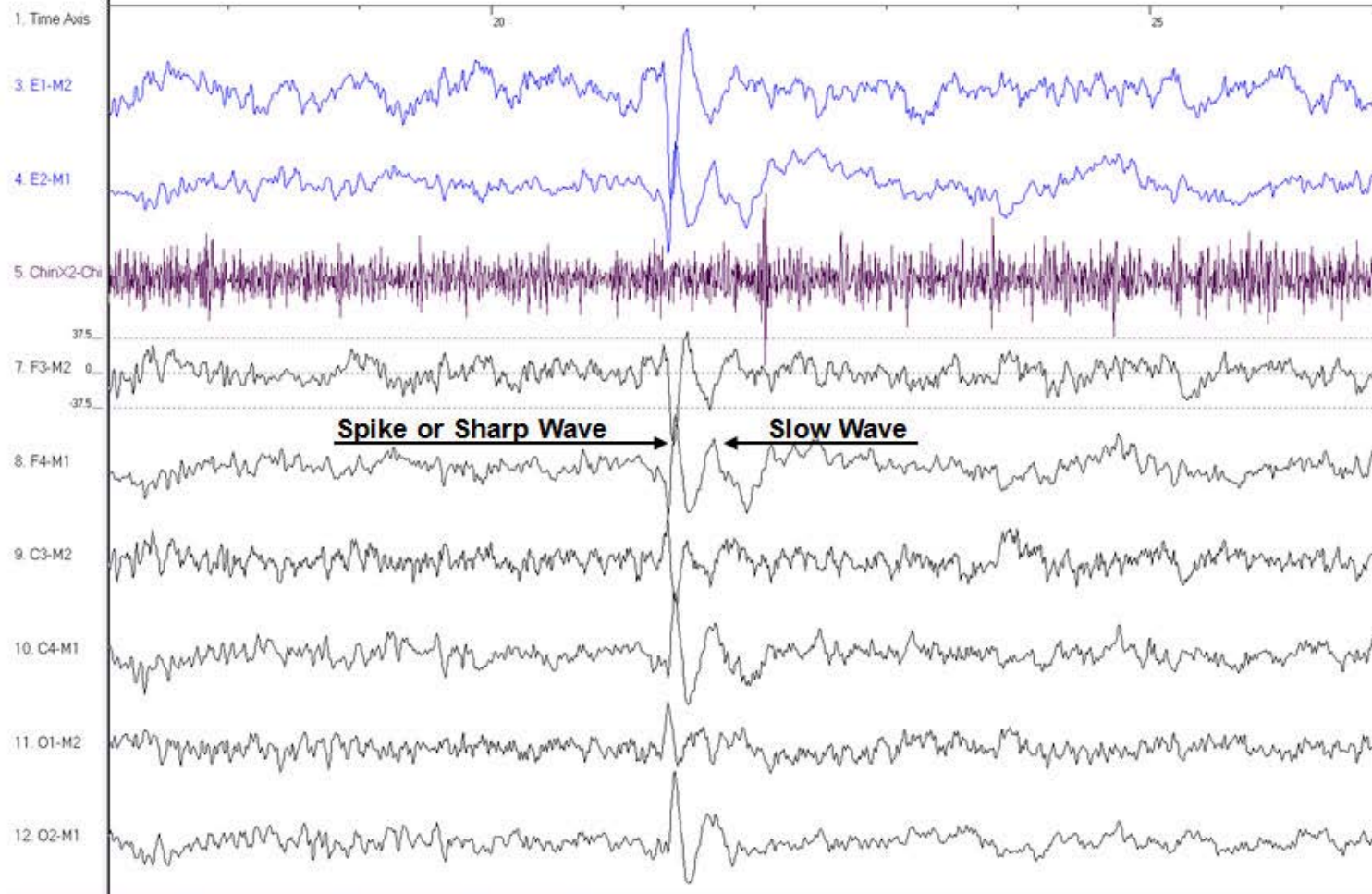
- A. Interictal epileptiform discharge
- B. Vertex sharp wave
- C. Blink artifact
- D. Muscle twitch artifact



What is the waveform shown by the arrow?

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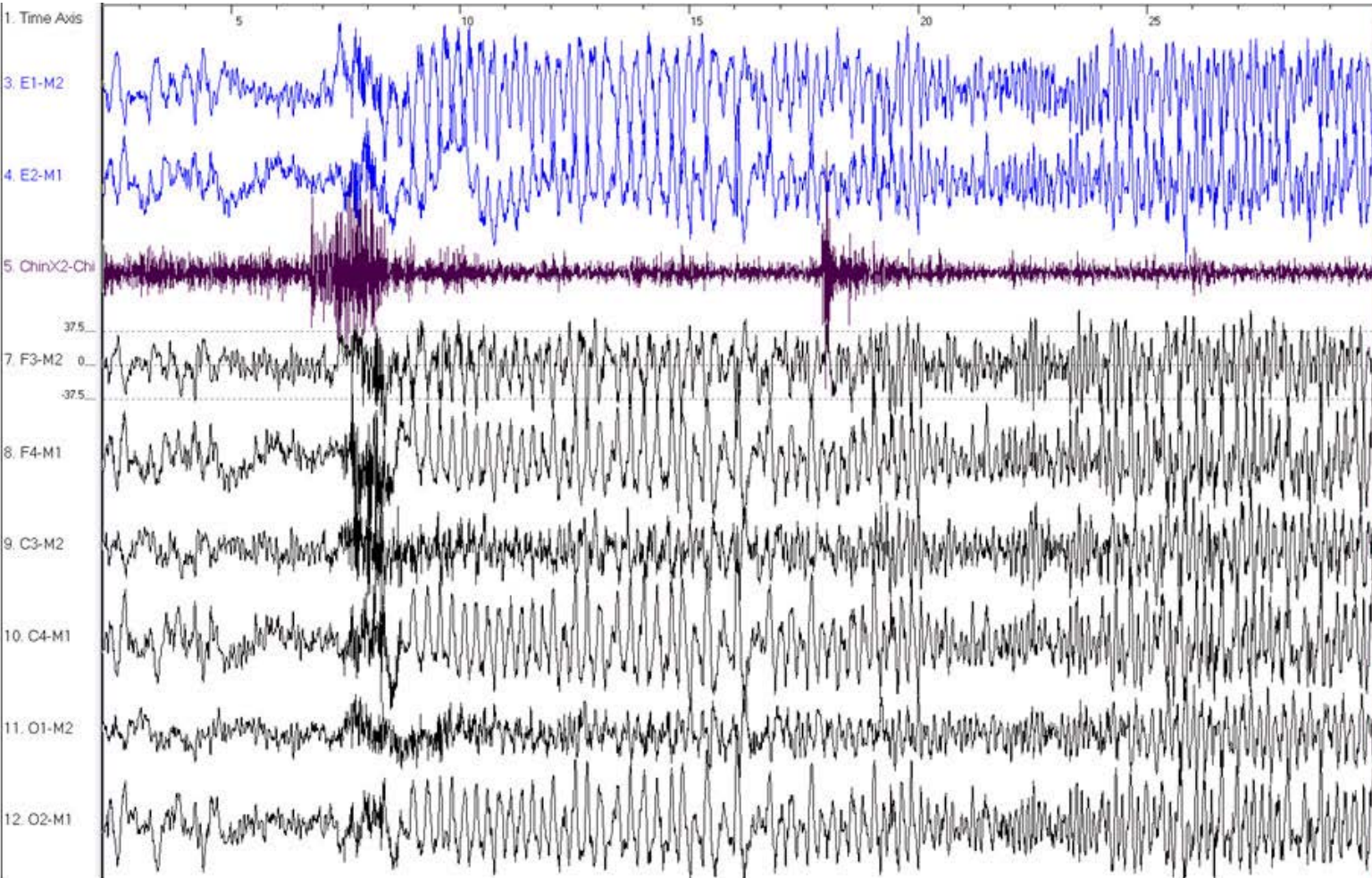




Later on in the study the following occurred...

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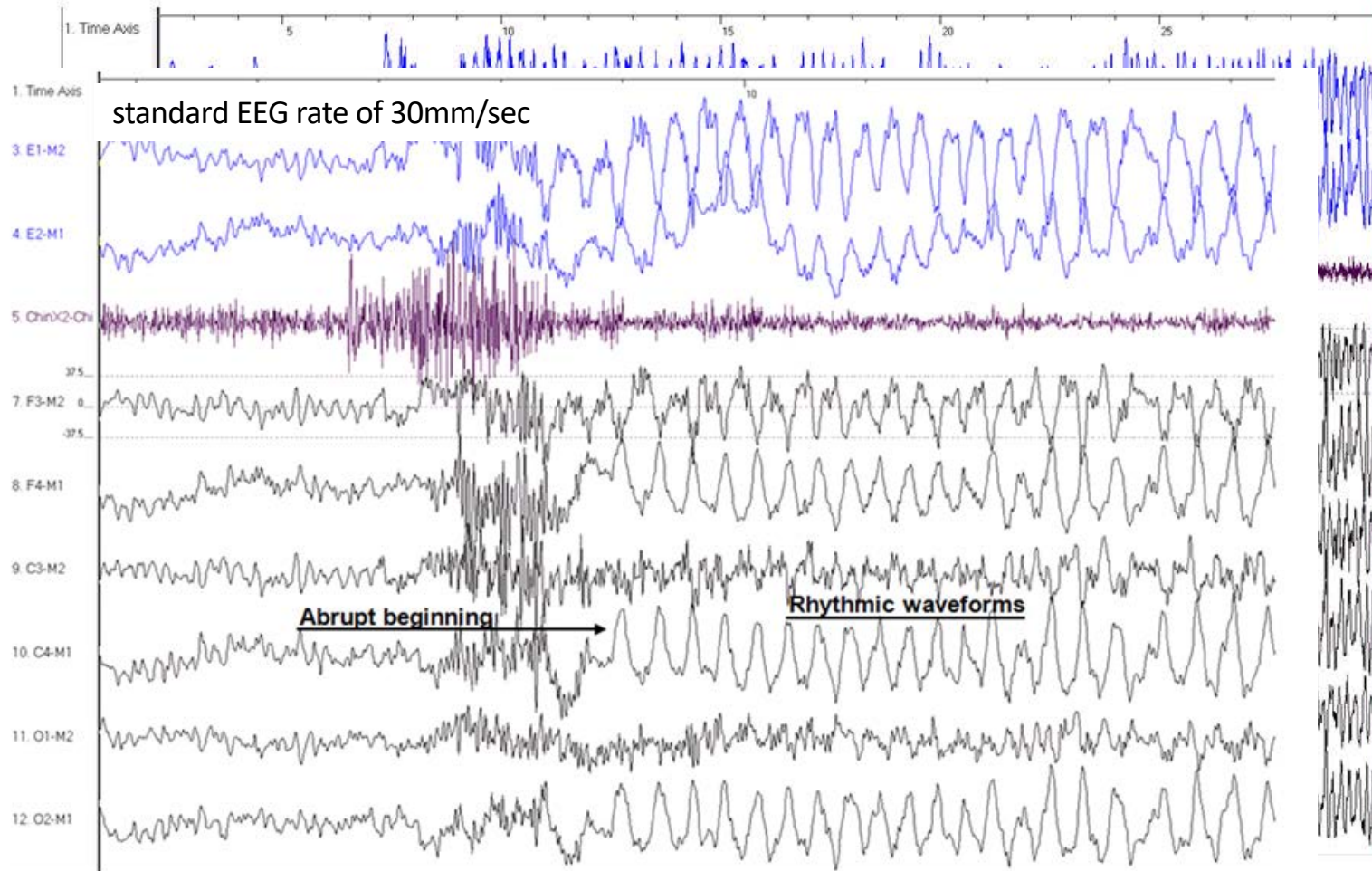


What does this epoch show?

- A. Tremor
- B. Shivering
- C. Ictal epileptiform activity
- D. Confusional arousal

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In what physiologic stage are seizures most likely to occur?

- A. REM sleep
- B. NREM sleep
- C. Wakefulness

Minecan B, et al. Relationship of epileptic seizures to sleep stage and sleep depth. *Sleep* 2002;25(8):899-904

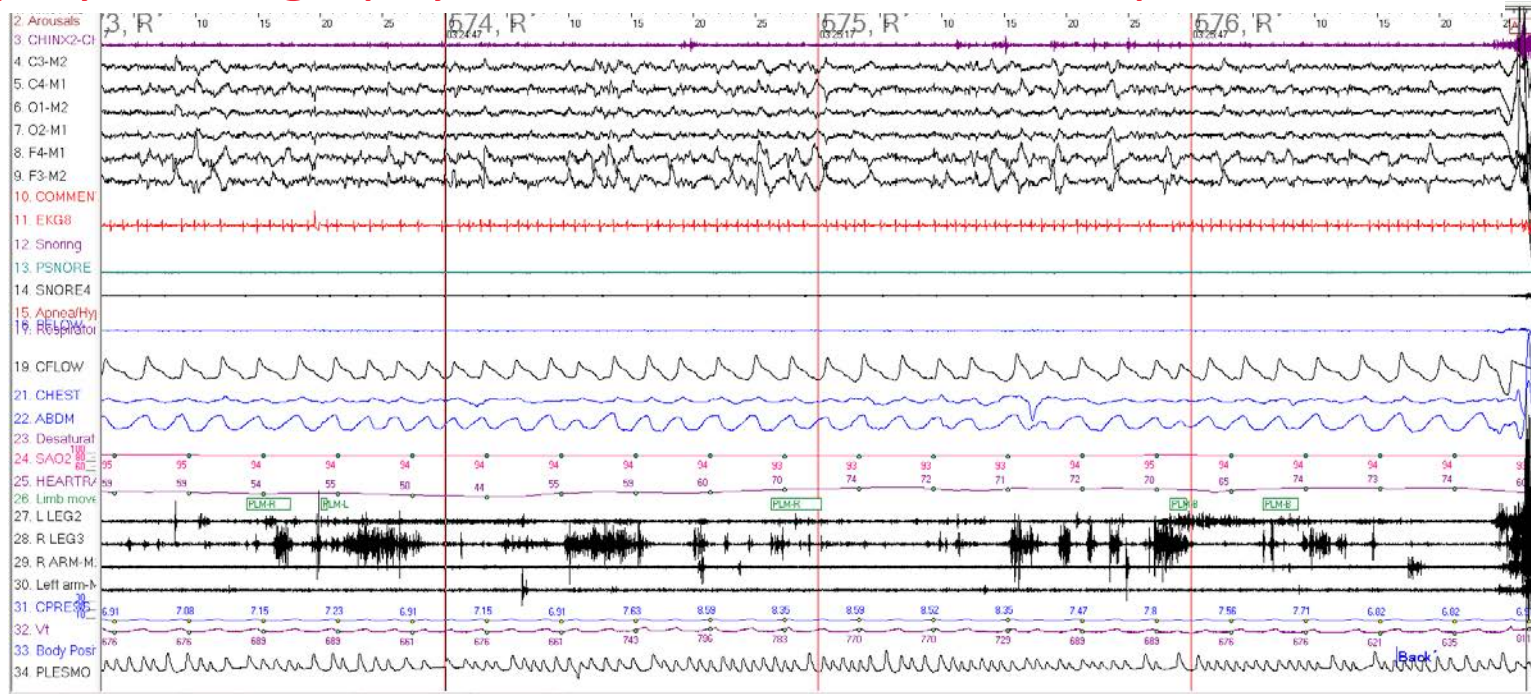
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Minecan B, et al. Relationship of epileptic seizures to sleep stage and sleep depth. *Sleep* 2002;25(8):899-904

A 71 year old patient complains of arms and legs flailing in his sleep. The following 120 second epoch is from his polysomnography and is scored as REM sleep.

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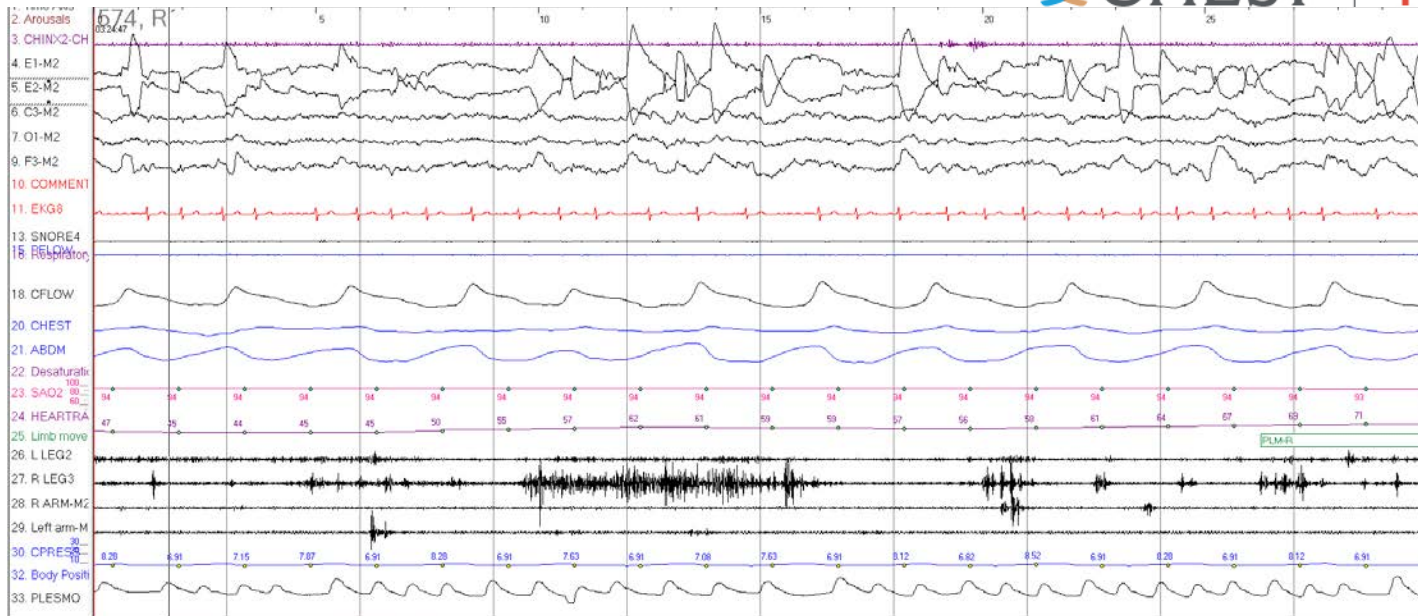


120 second epoch

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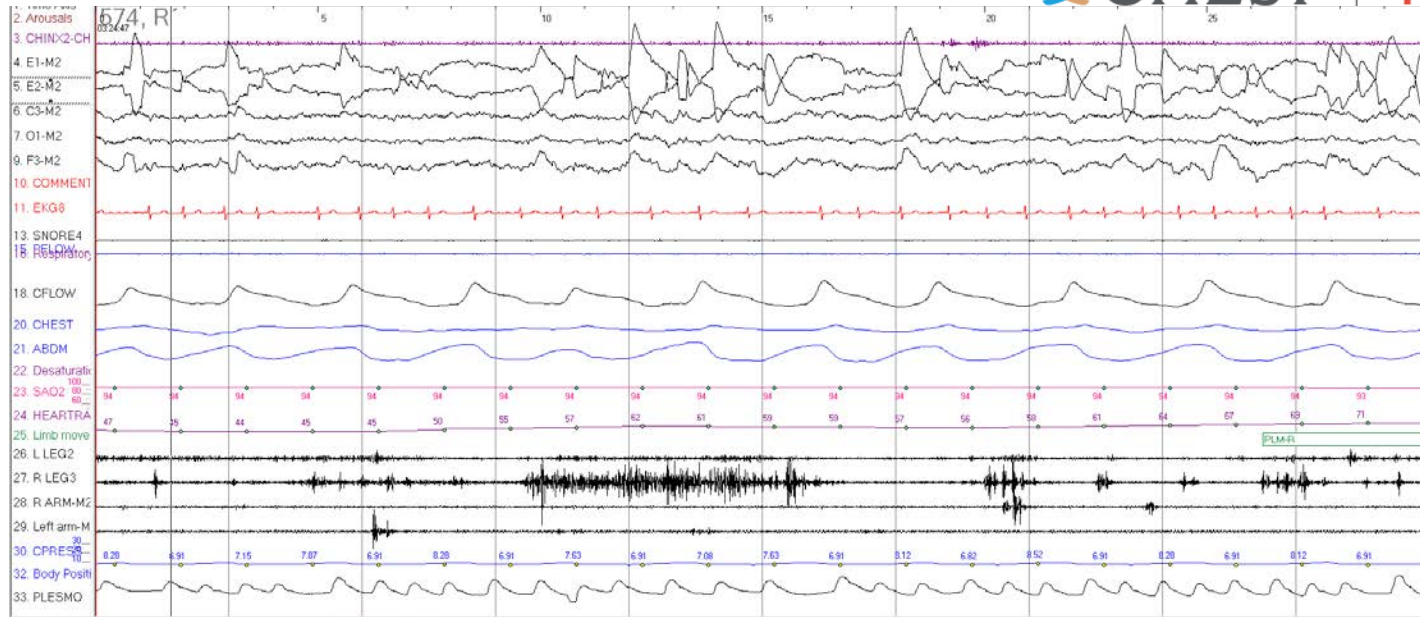
30 seconds



Does the following PSG fragment meet criteria for REM Behavior Disorder?

- A. Yes
- B. No

30 seconds



Does the following PSG fragment meet criteria for REM Behavior Disorder?

- A. Yes
- B. No

Sustained muscle activity in REM sleep in the chin EMG

- An epoch of REM sleep with at least 50% of the duration of the epoch having a chin EMG amplitude greater than the minimum amplitude demonstrated in NREM sleep.

Excessive transient muscle activity during REM in the chin or limb EMG

- In a 30-second epoch of REM sleep divided into 10 sequential 3-second mini-epochs, at least 5 (50%) of the mini-epochs contain bursts of transient muscle activity
- Excessive transient muscle activity bursts are 0.1-5.0 seconds in duration and at least 4 times as high in amplitude as the background EMG activity.

Which medication is most likely to cause an increased tone in REM sleep (disrupted REM atonia)?

- A. bupropion
- B. clonazepam
- C. donepezil
- D. fluoxetine

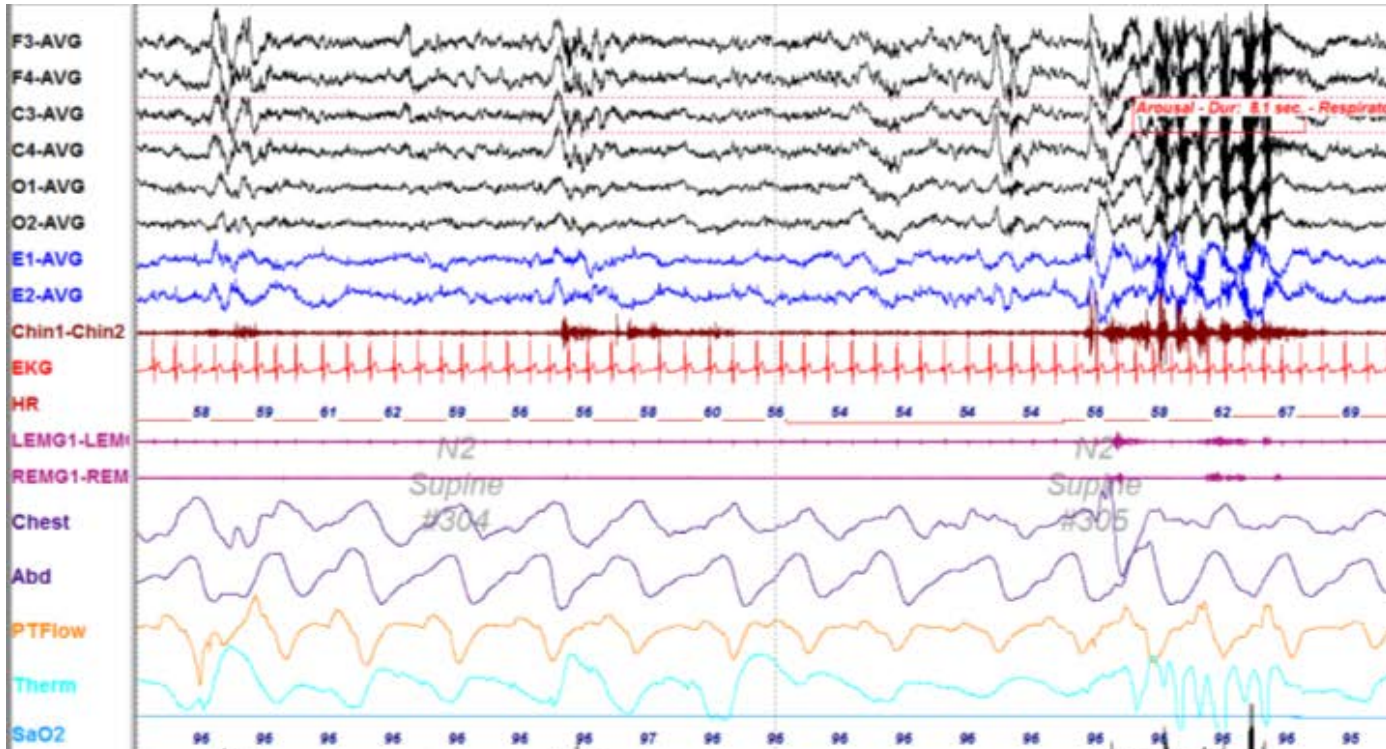
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Disrupt REM Atonia

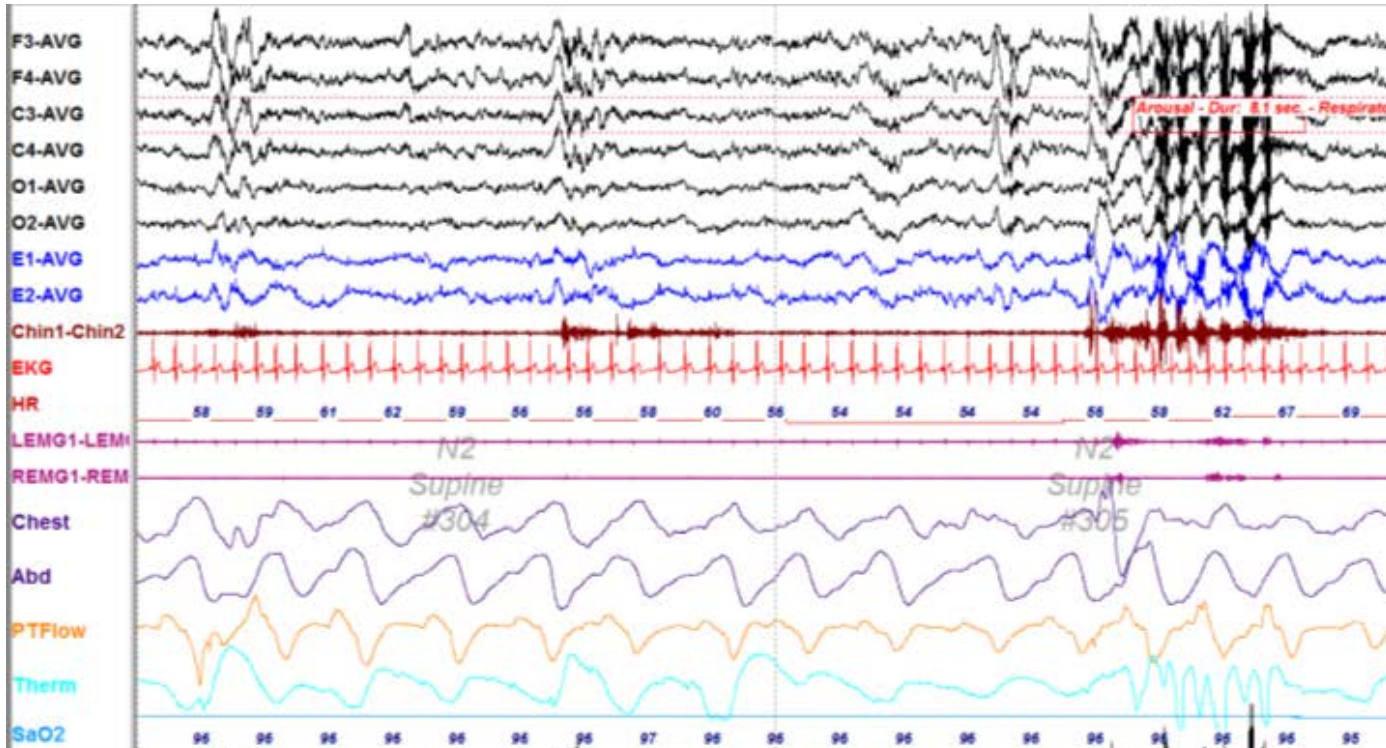
- serotonin-selective receptor inhibitor (SSRI's) → fluoxetine
- tricyclic antidepressants (TCA's)
- monoamine oxidase inhibitors (MAOI's)

What is the best description of the following polysomnogram finding in a 49 year old male?



- A. Seizure activity
- B. Head banging
- C. Bruxism
- D. Hypnic jerk

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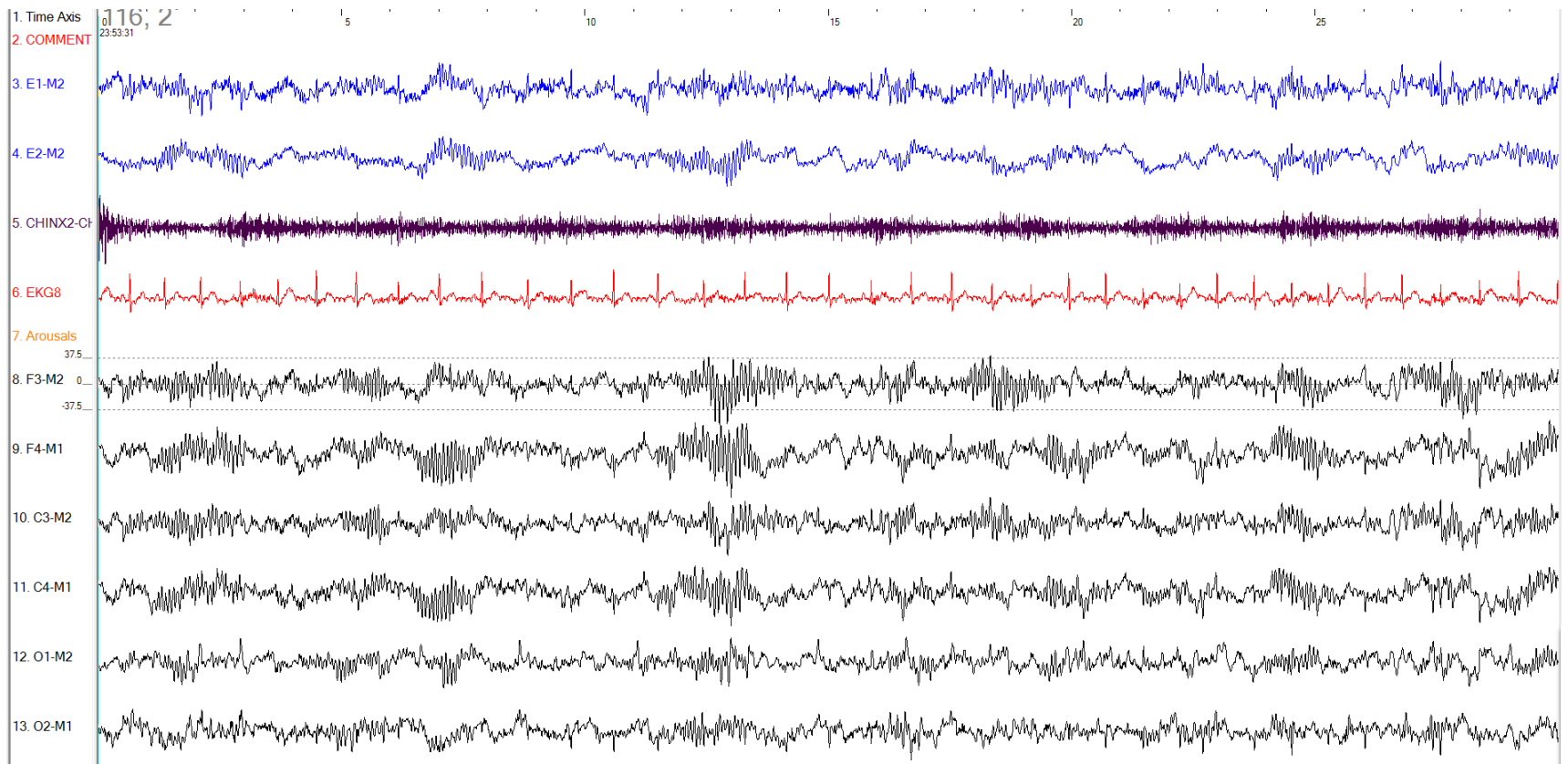
- A. Seizure activity
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- D. Hypnic jerk

Bruxism:

Bruxism may consist of brief (phasic) or sustained (tonic) elevations of chin EMG activity that are at least twice that of the background EMG

- **Phasic:** brief elevations of 0.25-2 seconds in duration and a minimum of 3 in sequence
- **Tonic:** sustained elevations in chin EMG for greater than 2 seconds

A 43 yo female referred for evaluation of chronic insomnia. She undergoes complete evaluation and therapy is initiated. Due to snoring and continues arousals from sleep a PSG is ultimately done.

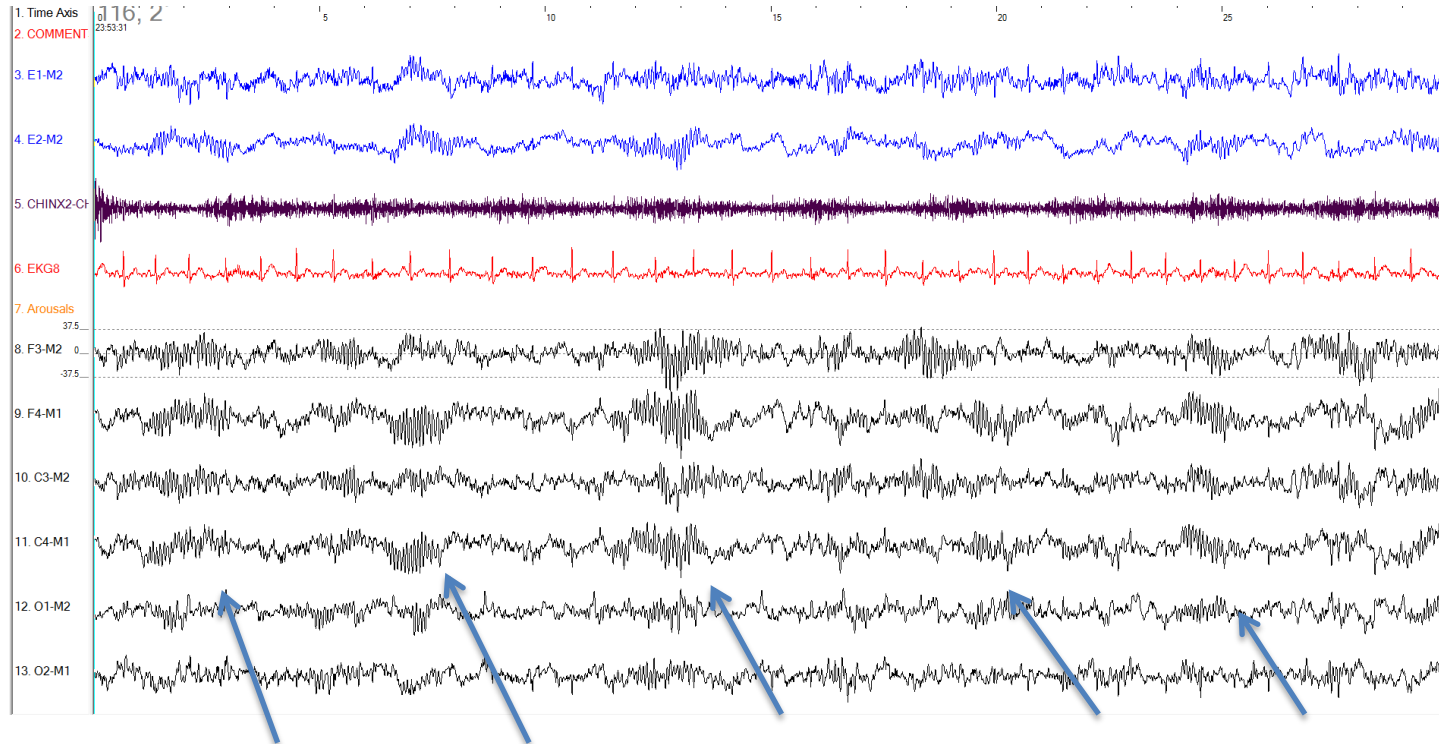


Based on the previous PSG fragment which of the following treatments was most likely initiated?

- A. stimulus control therapy
- B. mirtazapine
- C. temazepam
- D. diphenhydramine

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Which of the following effects on sleep are observed with the administration of benzodiazepines at therapeutic doses?

- A. increased REM and decreased N3 sleep
- B. increased REM and no effect on N3 sleep
- C. decreased REM and decreased N3 sleep
- D. decreased REM sleep and increased N3 sleep

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- B. increased REM and no effect on N3 sleep
- C. decreased REM and decreased N3 sleep
- D. decreased REM sleep and increased N3 sleep

Benzodiazepines have the following effects:

- ↑ increased stage N2
- ↑ increased sleep spindles
- ↓ sleep latency
- ↓ stage changes
- ↓ stage N1 sleep
- ↓ stage N3 sleep
- ↓ stage R (REM) sleep

Qureshi, A., 2004 *Medical Clinics of North America* 88, 751-766

A patient undergoes a multiple sleep latency test with the following results. What is this patient's mean sleep latency?

Nap	1	2	3	4	5
Sleep Latency	3minutes	5 minutes	2 minutes	No sleep	No sleep
SOREM	No	Yes	No	n/a	n/a

- A. 2 minutes
- B. 10 minutes
- C. 3.3 minutes
- D. 7.5 minutes

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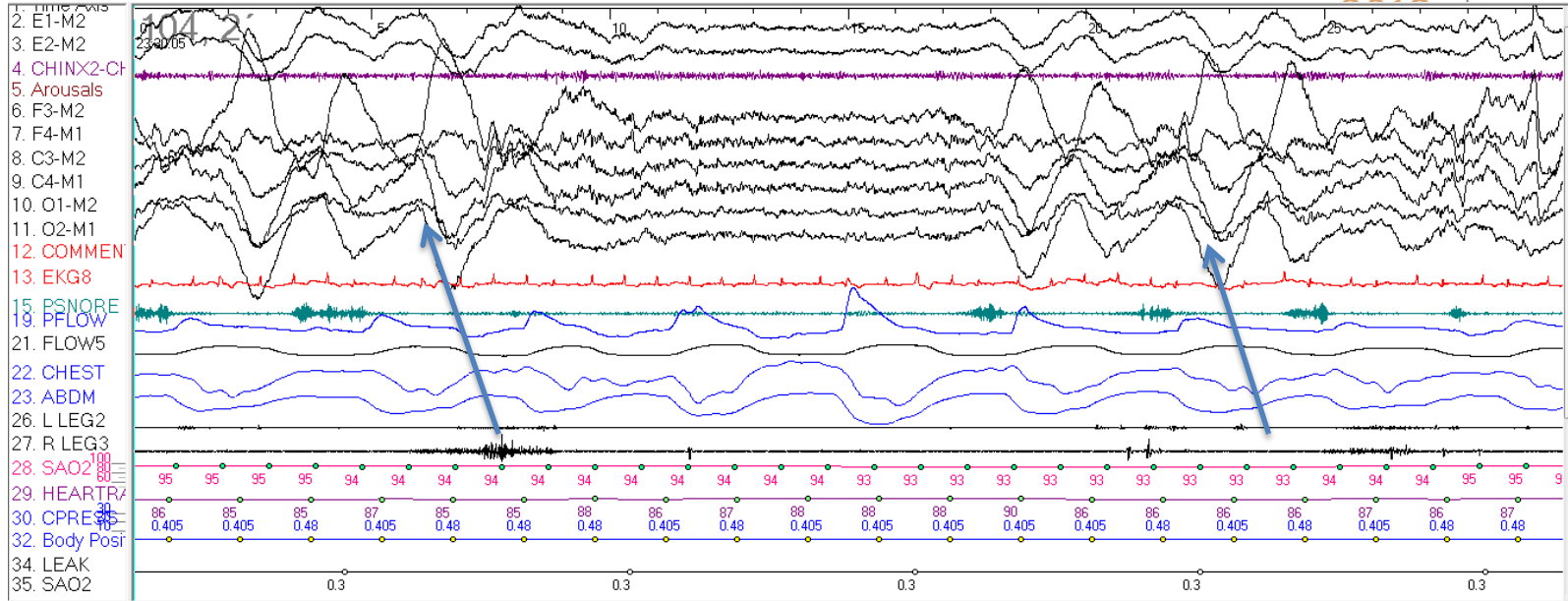
- A. 2 minutes
- B. 10 minutes**
- C. 3.3 minutes
- D. 7.5 minutes

Nap	1	2	3	4	5
Sleep Latency	3minutes	5 minutes	2 minutes	No sleep	No sleep
SOREM	No	Yes	No	n/a	n/a

No nap counts as the full 20 minutes
 $(3+5+2+20+20)/5 = 10$

What the best description of the findings in this epoch?

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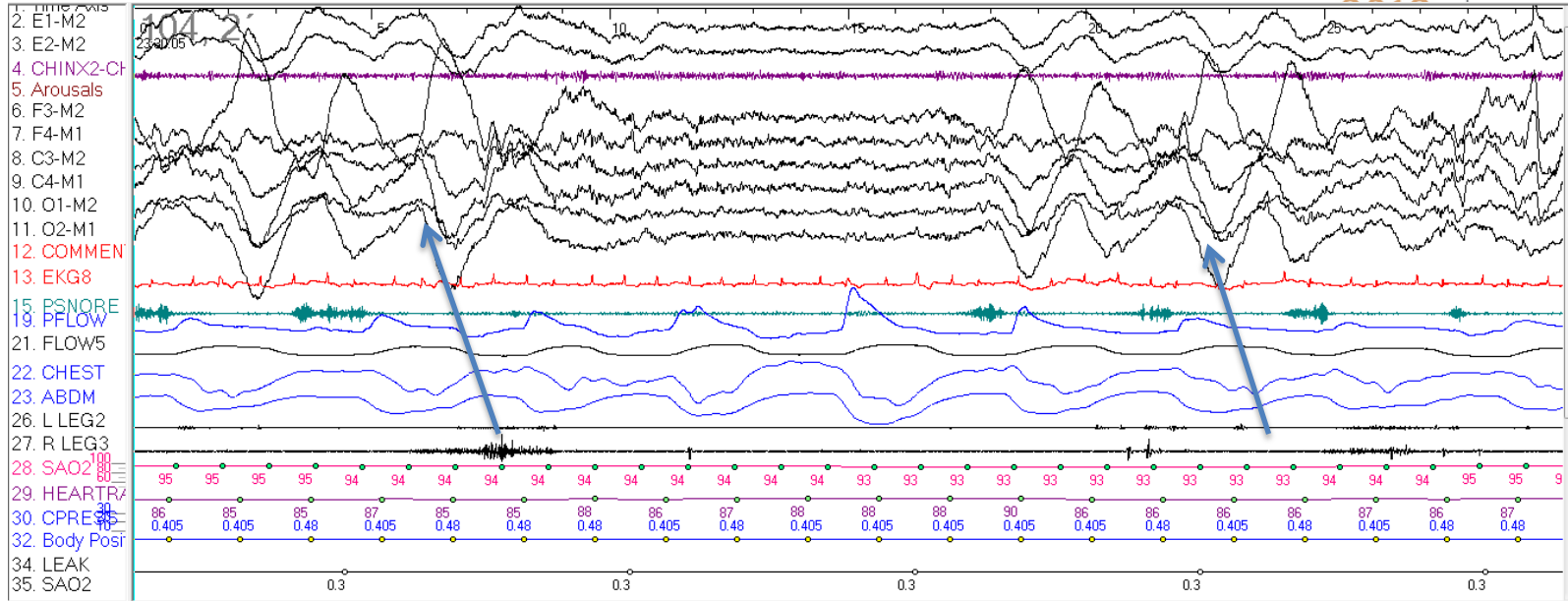
- A. Sweat artifact
- B. Delta waves
- C. Muscle artifact
- D. Electrode popping

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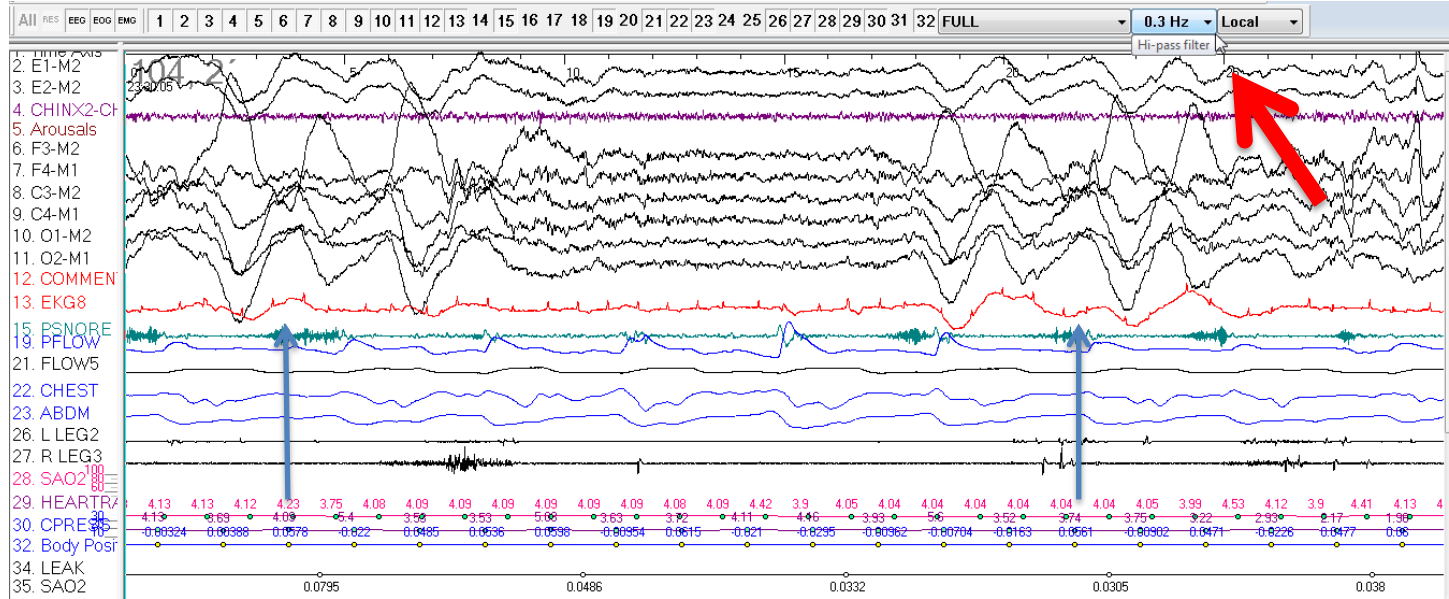


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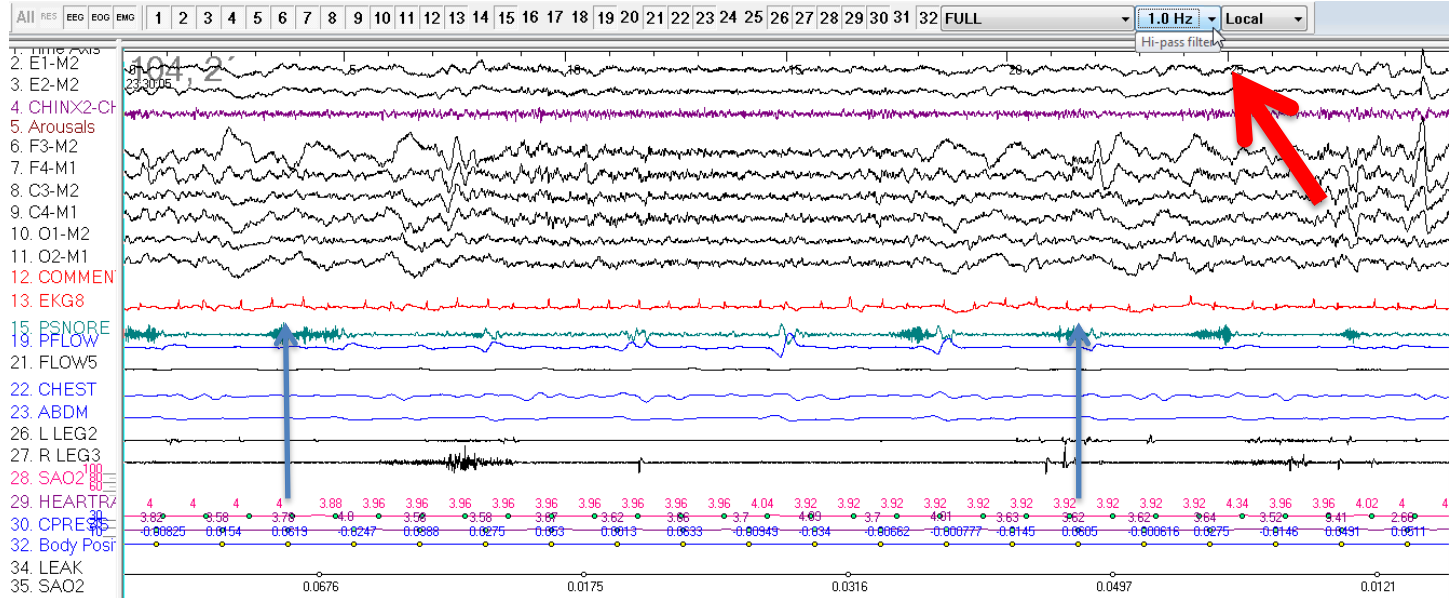
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Sweat Artifact



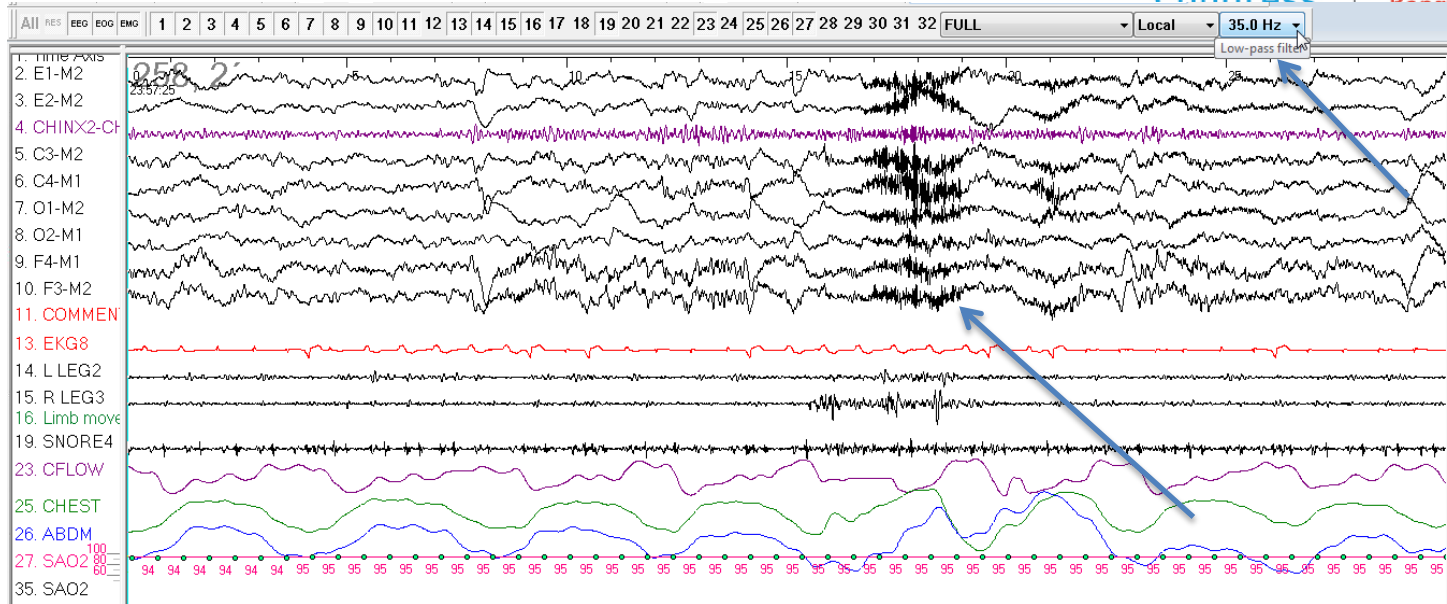
- Typically seen in EEG (Occipital leads- pt on back)
- Slow (<2Hz)
- Disappears in REM (no thermoregulation)
- Trouble shooting sweat artifact:
 - Lower room temp or change patient position
 - Adjust low frequency filter (increase from 0.3Hz to 0.5 or 1.0 Hz)

Sweat Artifact



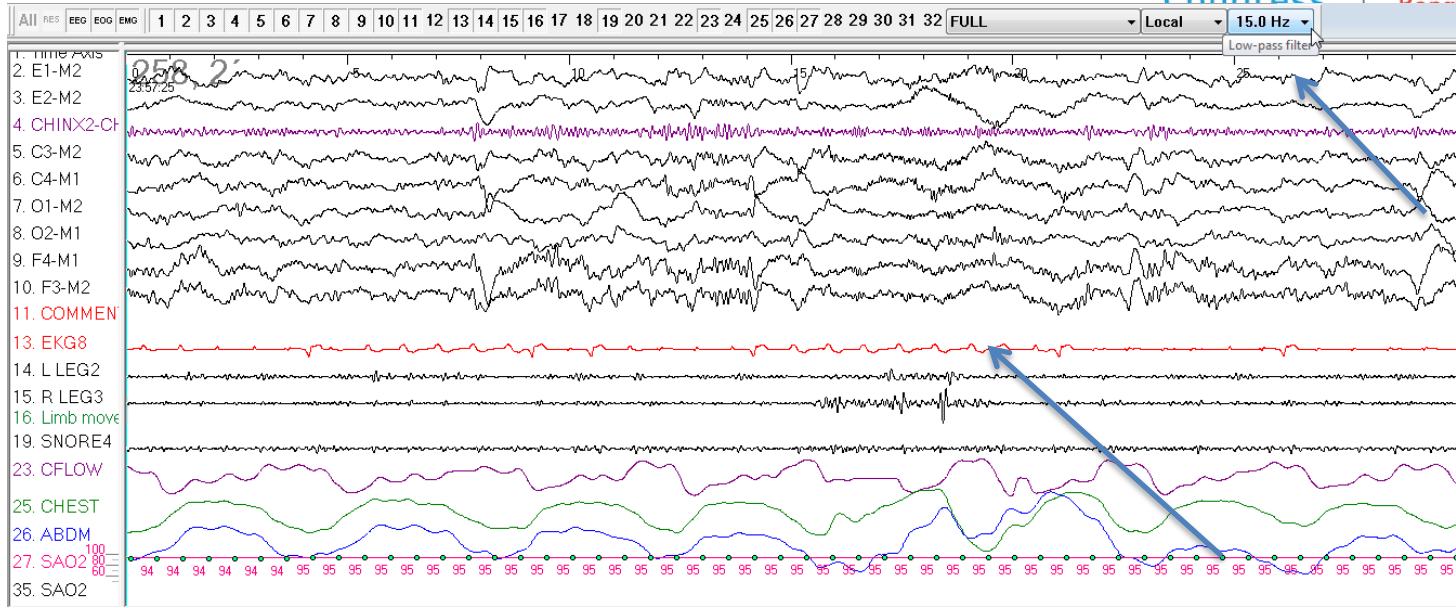
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- Slow (<2Hz)
- Disappears in REM (no thermoregulation)
- Trouble shooting sweat artifact:
 - Lower room temp or change patient position
 - Adjust low frequency filter (increase from 0.3Hz to 0.5 or 1.0 Hz)
 - Caution when scoring! delta wave amplitude may be attenuated if you increase low frequency filter

Muscle Artifact



- Fast (10-70Hz)
- Do not misinterpret as arousals or spindles

Muscle Artifact



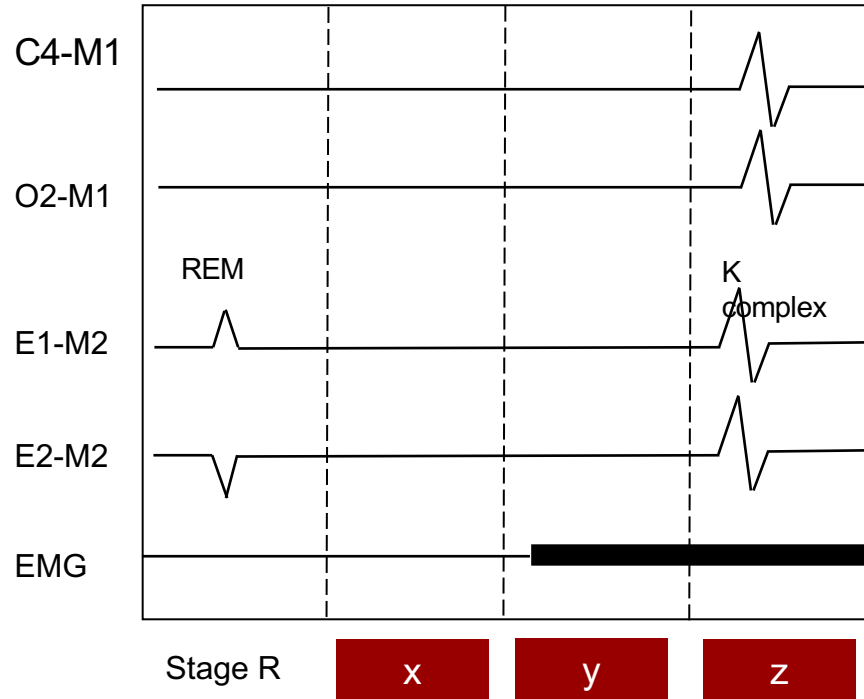
- Fast (10-70Hz)
- Do not misinterpret as arousals or spindles
- Troubleshooting if persistent:
 - Reduce high frequency filter (reduce from 35Hz to 15Hz)
 - Caution scoring as you may miss arousals and spindles due to attenuation of higher frequency waves

REM RULES

Name that Stage!

Which of the following represents x,y,z?

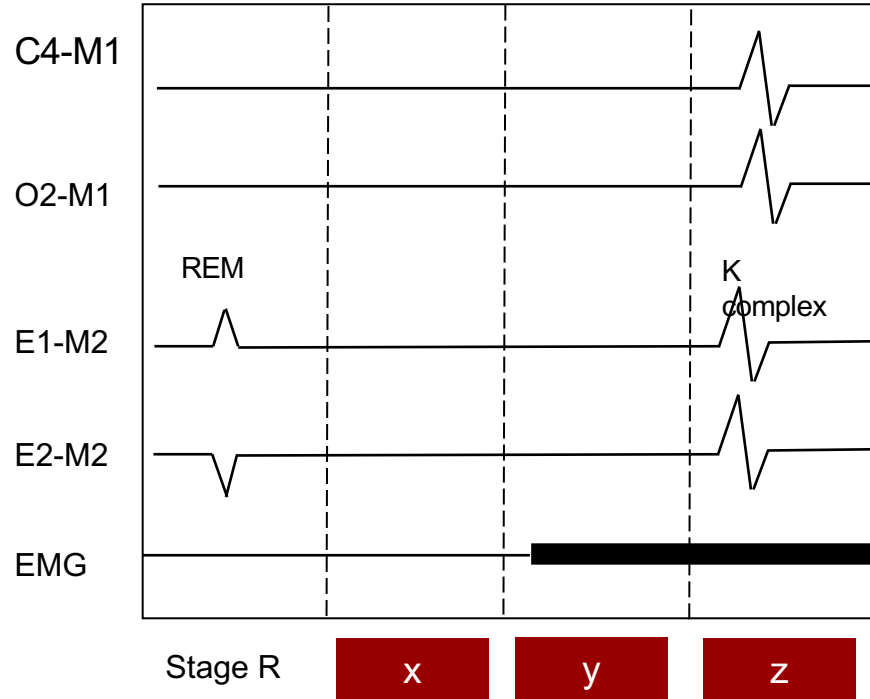
- A. N1,N1,N2
- B. R,N2,N2
- C. R,R,N2
- D. R,N1,N2



Name that Stage!

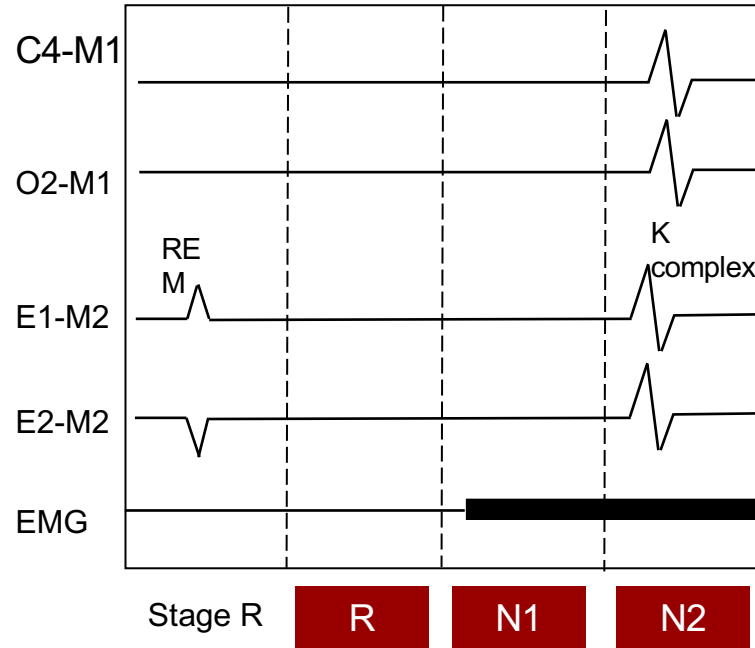
Which of the following represents x,y,z?

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- C. R,R,N2
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Scoring Rule

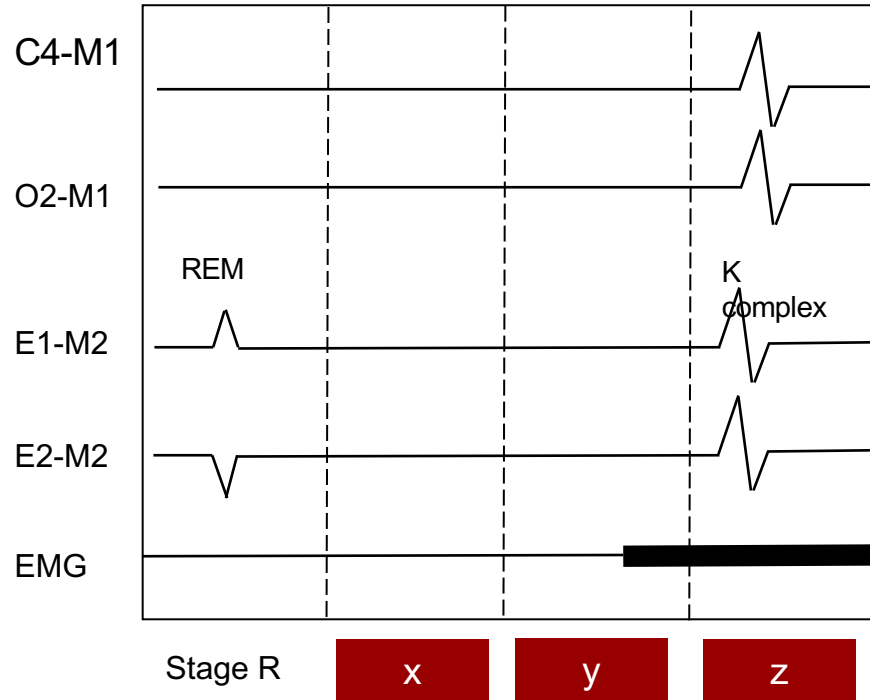
Continue to score stage R even in the absence of rapid eye movements, if the EMG tone remains low and without K complexes or sleep spindles



Name that Stage!

Which of the following represents x,y,z?

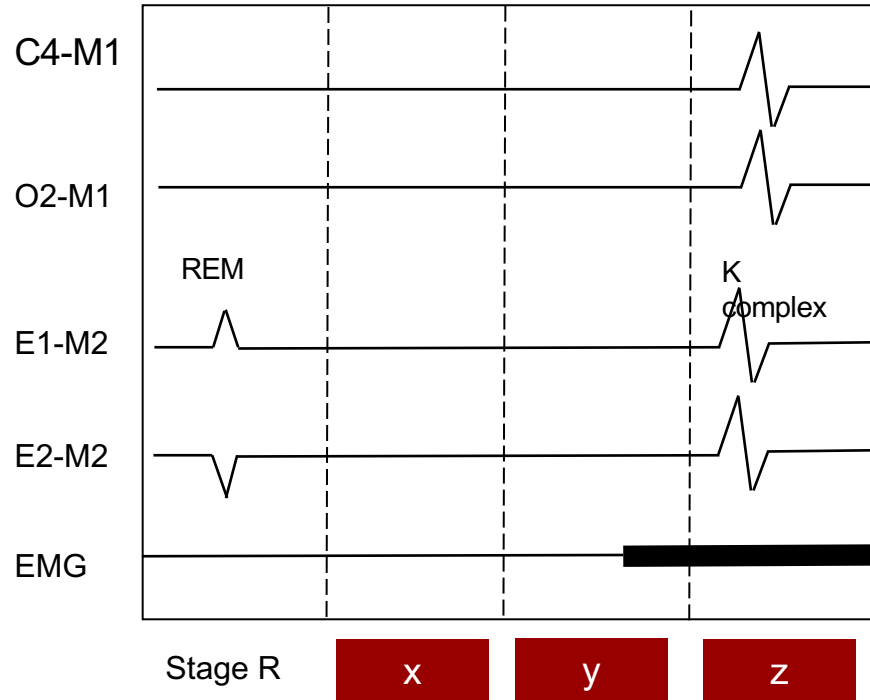
- A. N1,N1,N2
- B. R,N2,N2
- C. R,R,N2
- D. R,N1,N2



Name that Stage!

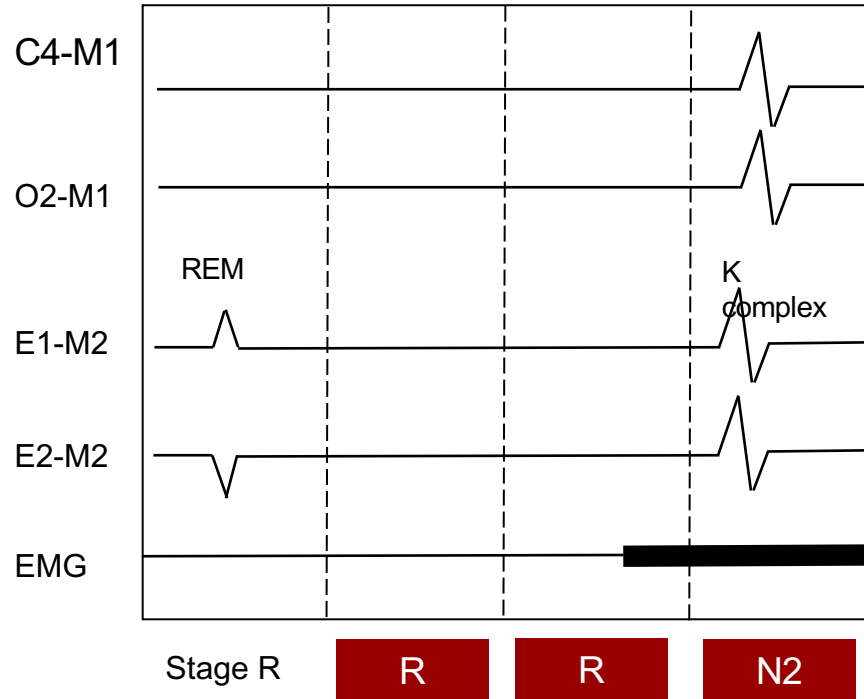
Which of the following represents x,y,z?

- A. N1,N1,N2
- B. R,N2,N2
- C. R,R,N2
- D. R,N1,N2



Scoring Rule

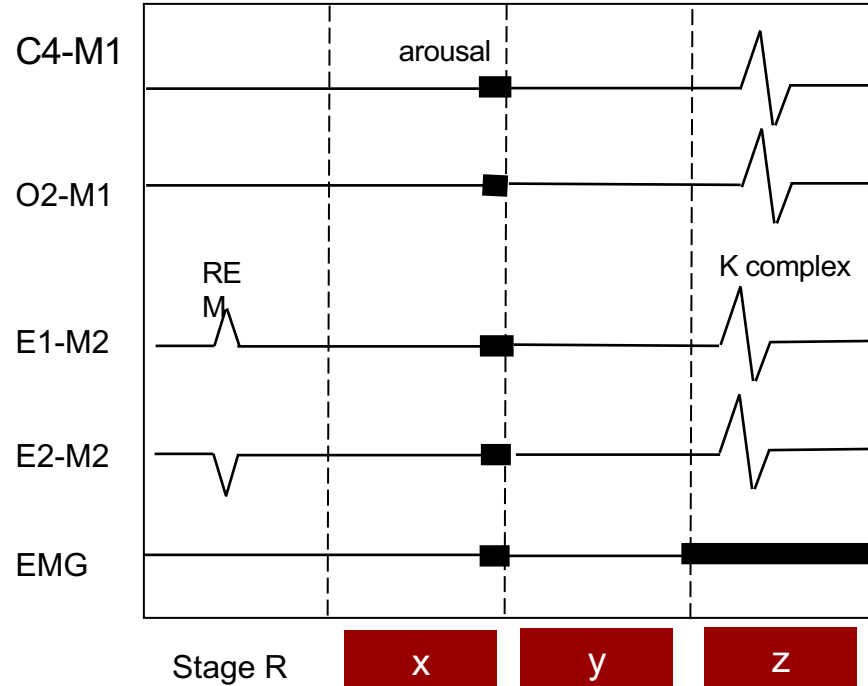
Continue to score stage R if the EMG tone remains low throughout **the first half** of epoch and without K complexes or sleep spindles



Name that Stage!

Which of the following represents x,y,z?

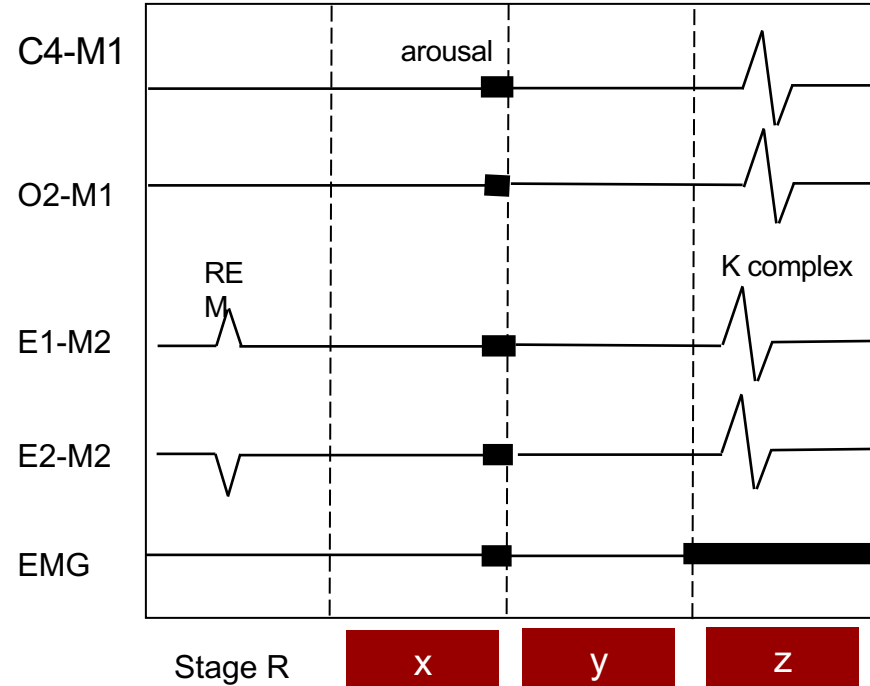
- A. R,R,N2
- B. R,W,N2
- C. R,N2,N2
- D. R,N1,N2



Name that Stage!

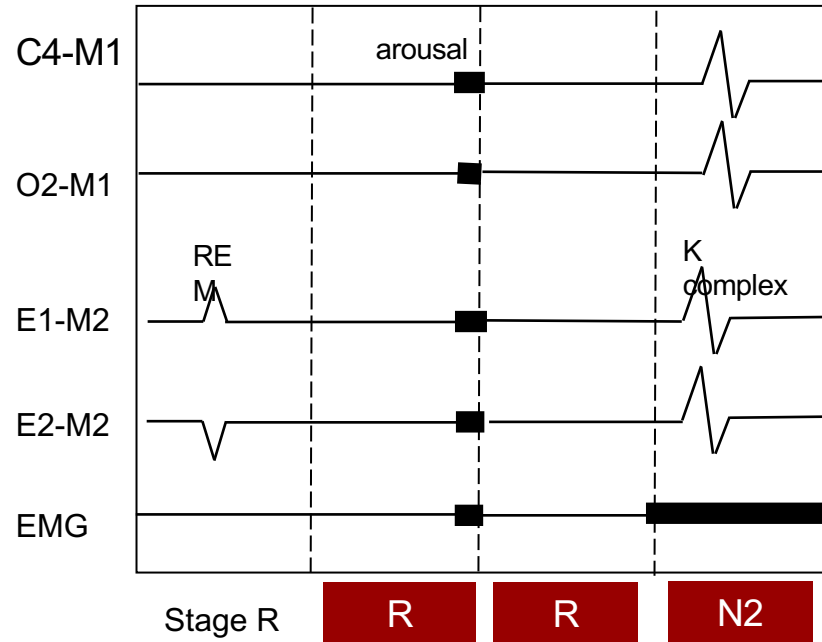
Which of the following represents x,y,z?

- A. R,R,N2
- B. R,W,N2
- C. R,N2,N2
- D. R,N1,N2



Scoring Rule

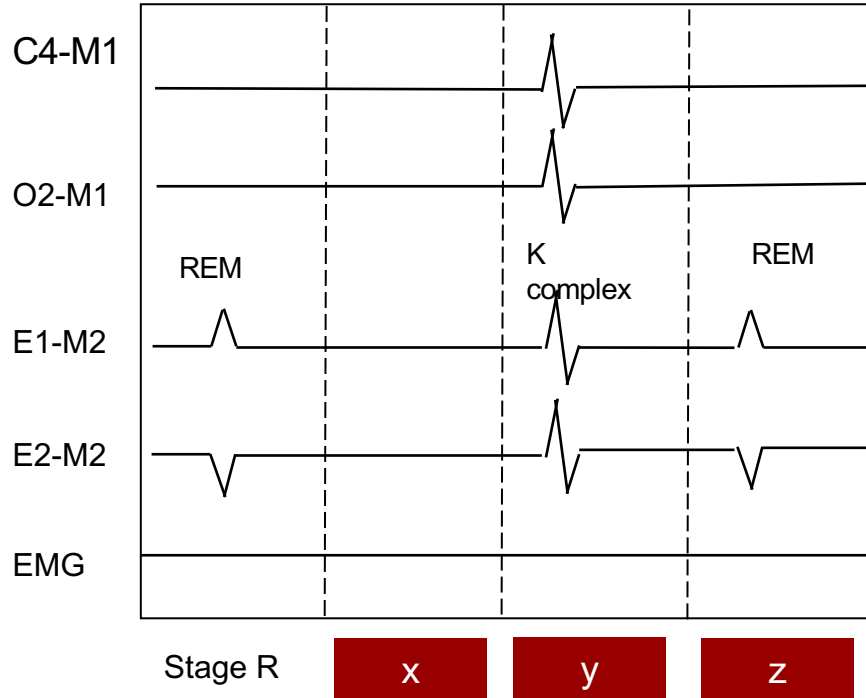
If an arousal occurs followed by low amplitude mixed frequency EEG and the chin EMG remains low, and there are no slow eye movements score as stage R



Name that Stage!

Which of the following represents x,y,z?

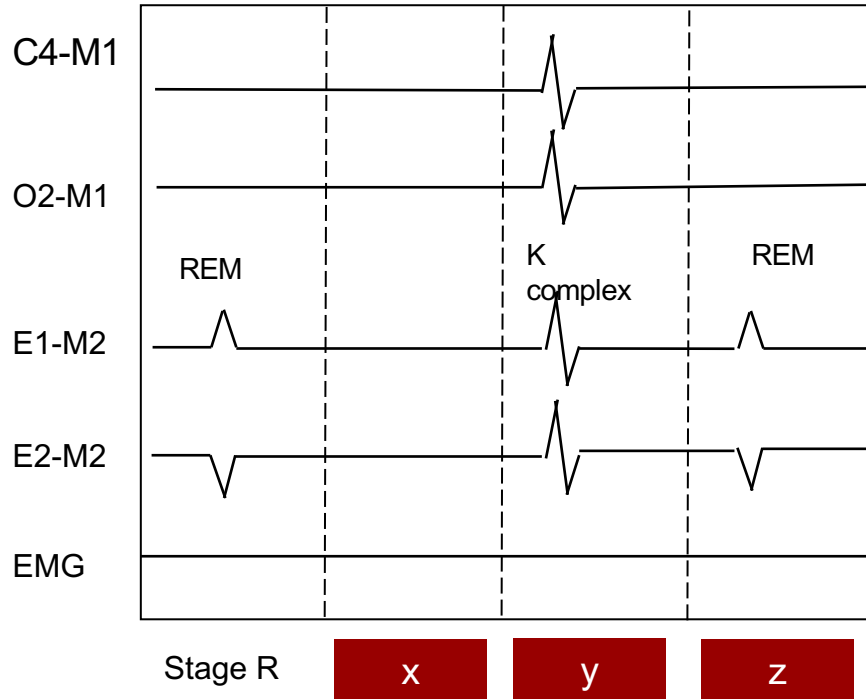
- A. R,R,R
- B. R,N2,R
- C. R,N2,N2
- D. N2,N2,N2



Name that Stage!

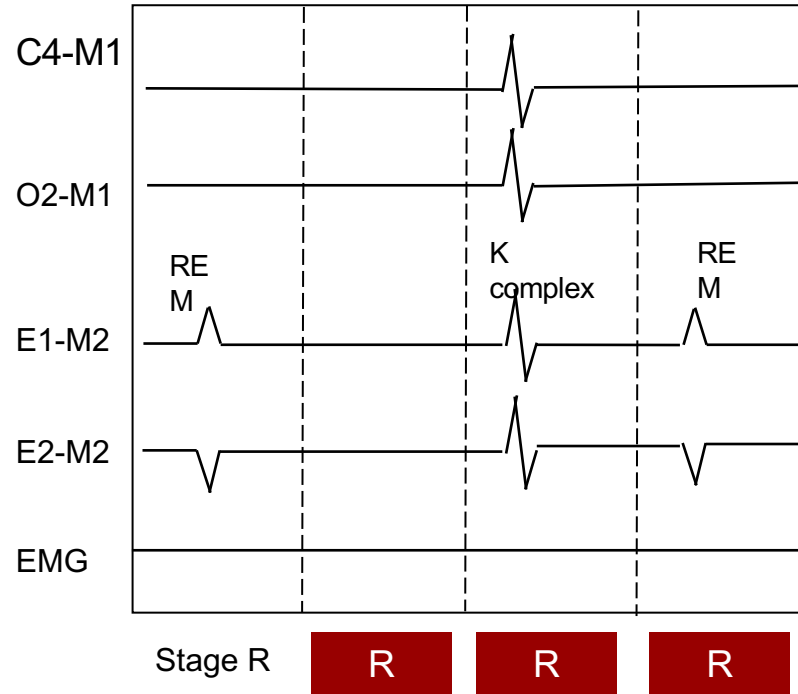
Which of the following represents x,y,z?

- A. R,R,R
- B. R,N2,R
- C. R,N2,N2
- D. N2,N2,N2



Scoring Rule!

If the majority of an epoch contains a segment of the recording meeting criteria for stage R, the epoch is scored as stage R. Stage R rules take precedence over stage N2 rules.

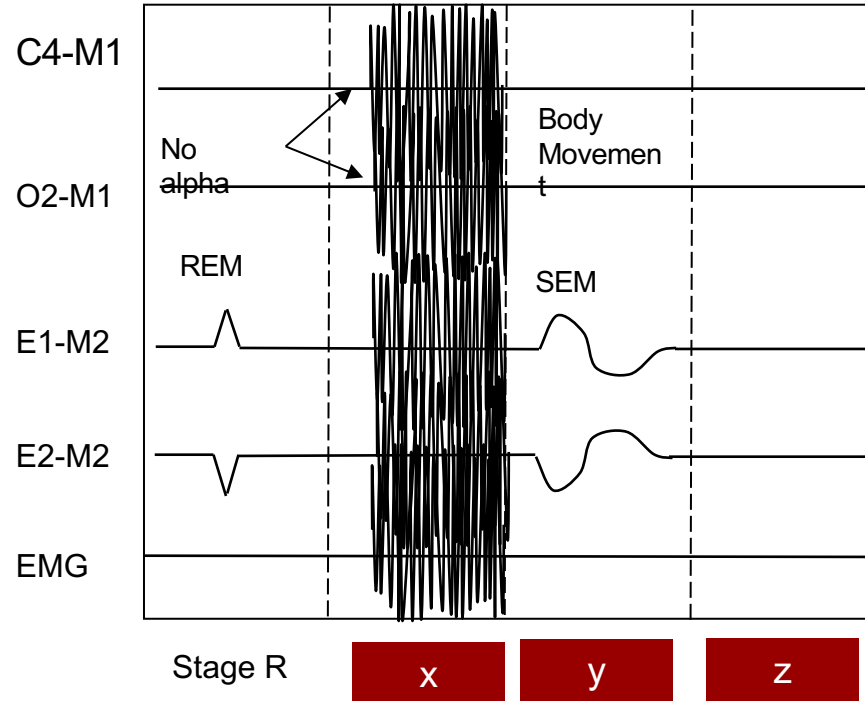


(Scoring stage R, see figure 11A for rule) American Academy of Sleep Medicine. The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications, Version 2.3

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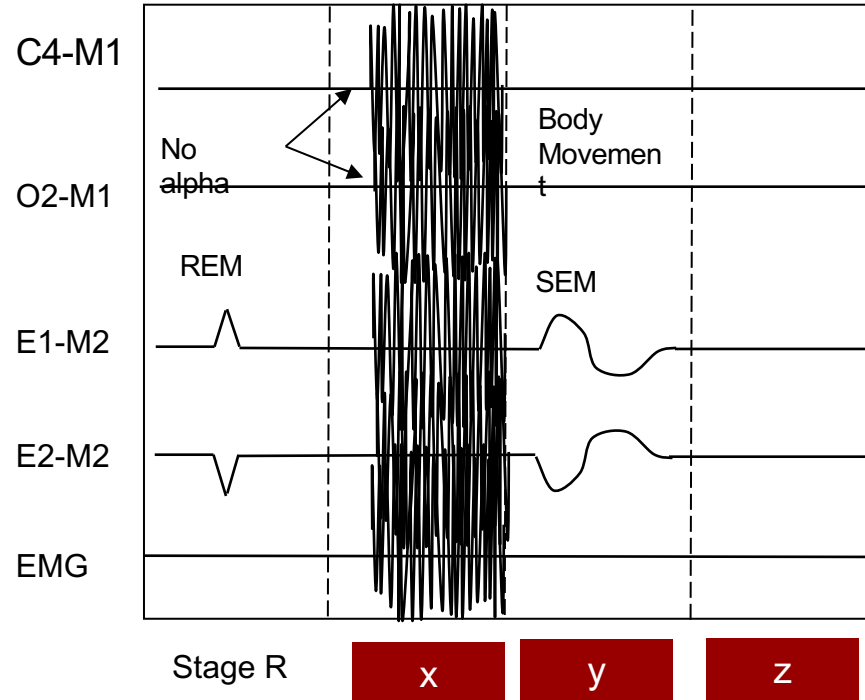
- A. R,R,N1
- B. W,N1,N1
- C. R,N1,N1
- D. N1,N1,N1



Name that Stage!

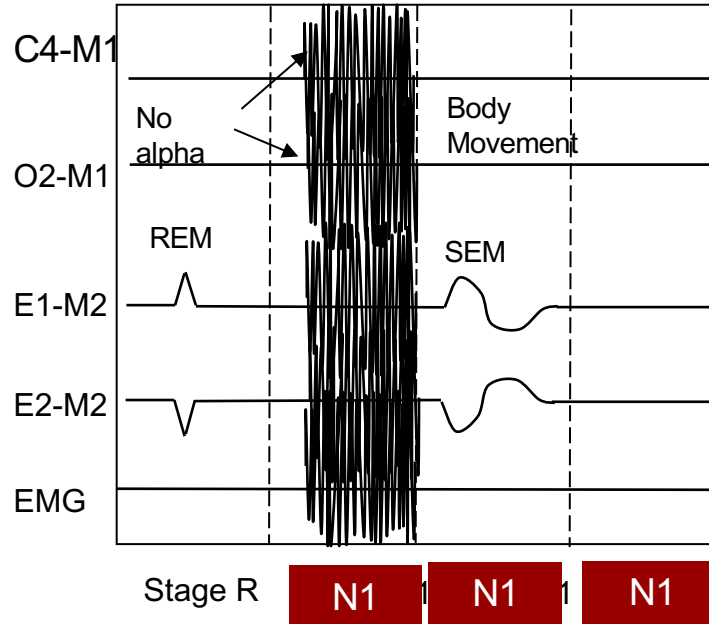
Which of the following represents x,y,z?

- A. R,R,N1
- B. W,N1,N1
- C. R,N1,N1
- D. N1,N1,N1



Scoring Rule: Major Body Movements

- If alpha rhythm is present for any part of the epoch (even <15 seconds duration), score as stage W
- If no alpha rhythm is discernible, but the preceding or following epoch is W, then score as stage W
- If no alpha is present and no surrounding epochs of W, score the epoch as the same stage as the epoch that follows it



In a patient with excessive daytime sleepiness, which of the following diagnostic testing results are consistent with narcolepsy type 2 according to the ICSD3?

	PSG REM Latency	Mean Sleep Latency on MSLT	# SOREM's on MSLT	CSF Hypocretin-1 Concentration	Cataplexy
A.	12 minutes	6 minutes	1	not obtained	no
B.	62 minutes	7.5 minutes	3	112 pg/mL	yes
C.	27 minutes	2 minutes	2	100 pg/mL	no
D.	17 minutes	9minutes	2	not obtained	no

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D.	17 minutes	9minutes	2	not obtained	no

At least 3 months of excessive daytime sleepiness not otherwise explained

Narcolepsy Type 1

- Cataplexy *and* a MSL of ≤ 8 minutes *and* ≥ 2 SOREM on an MSLT. (A SOREM (within 15 minutes of sleep onset) on the preceding PSG may replace one of the SOREMs on the MSLT.)

OR

- CSF hypocretin-1 concentration, is either ≤ 110 pg/mL or $<1/3$ of mean normal values with the same standardized assay.

Narcolepsy Diagnostic Criteria

At least 3 months of excessive daytime sleepiness not otherwise explained

Narcolepsy Type 2

- A MSL of ≤ 8 minutes *and* ≥ 2 SOREM on an MSLT. (A SOREM (within 15 minutes of sleep onset) on the preceding PSG may replace one of the SOREMs on the MSLT.)
- Cataplexy is absent.
- *Either* CSF hypocretin-1 concentration has not been measured *or* CSF hypocretin-1 concentration, is either > 110 pg/mL or $>1/3$ of mean normal values with the same standardized assay.

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D.	17 minutes	9 minutes	2	not obtained	no

Choice A has no cataplexy and normal hypocretin-1 in the setting of an MSL ≤ 8 and 2 SOREM's (one is in the PSG) consistent with narcolepsy type 2

Choice B has cataplexy making it consistent with narcolepsy type 1

Choice C has CSF hypocretin ≤ 110 making it consistent with narcolepsy type 1

Choice D has an MSL > 8 making it inconsistent with narcolepsy

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