



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

EEG patterns in status epilepticus

นพ. ทิพากร ตุ่มนาค

สถาบันประสาทวิทยา กรุงเทพมหานคร



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

INTERICTAL EPILEPTIFORM DISCHARGES

Interictal epileptiform discharges aid in the diagnosis of epilepsy and are sometimes the only abnormal finding encountered on routine EEG.

ICTAL DISCHARGES

An epileptic seizure is defined as “a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain.”

According to their clinical and electrographic onsets, seizures are classified as focal, generalized, or unknown

ICTAL PATTERNS

observed EEG changes during seizures. The ictal discharges during seizures do not always consist of repetitive spikes or sharp waves; instead, ictal discharges vary in morphology (eg, sharply contoured or not), frequency, and distribution. Frequently, ictal discharges show evolution patterns with changes in **frequency, amplitude, field, or morphology** during the course of the seizure

Classification of status epilepticus .



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

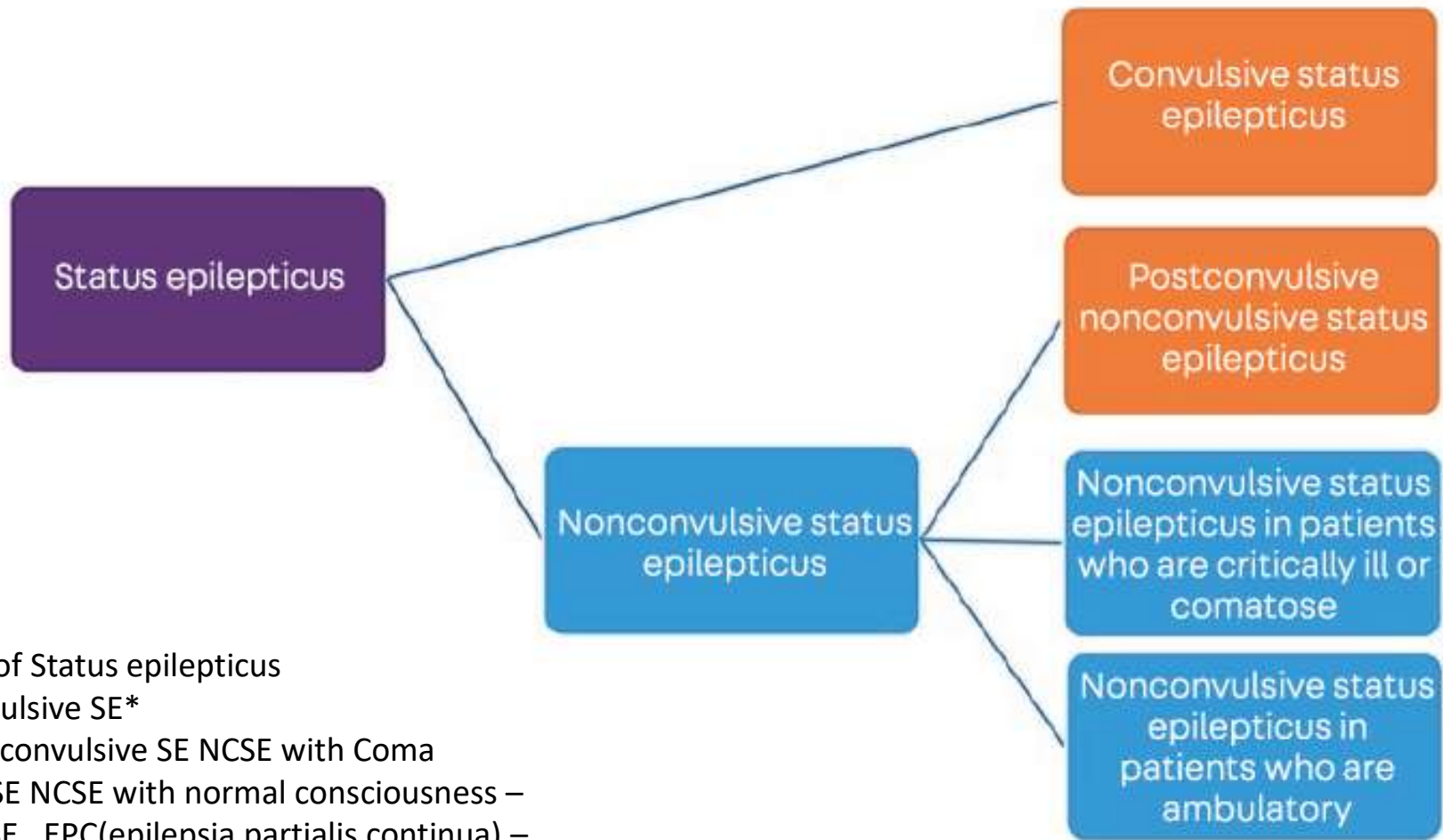
SPECIAL REPORT

A definition and classification of status epilepticus – Report of the ILAE Task Force on Classification of Status Epilepticus

*†‡Eugen Trinka, §Hannah Cock, ¶Dale Hesdorffer, #Andrea O. Rossetti, **Ingrid E. Scheffer, ††Shlomo Shinnar, ‡‡Simon Shorvon, and §§Daniel H. Lowenstein

Epilepsia, 56(10):1515–1523, 2015
doi: 10.1111/epi.13121

Epilepsia, 56(10):1515–1523, 2015



Types of Status epilepticus

- Convulsive SE*
- Non-convulsive SE NCSE with Coma
- suble SE NCSE with normal consciousness –
- Focal SE , EPC(epilepsia partialis continua) –
- Focal SE with dyscognitive feature –
- Generalized : Absence Seizure



Table 1. Operational dimensions with t_1 indicating the time that emergency treatment of SE should be started and t_2 indicating the time at which long-term consequences may be expected

Type of SE	Operational dimension 1 Time (t_1), when a seizure is likely to be prolonged leading to continuous seizure activity	Operational dimension 2 Time (t_2), when a seizure may cause long term consequences (including neuronal injury, neuronal death, alteration of neuronal networks and functional deficits)
Tonic-clonic SE	5 min	30 min
Focal SE with impaired consciousness	10 min	>60 min
Absence status epilepticus	10–15 min ^a	Unknown

^aEvidence for the time frame is currently limited and future data may lead to modifications.



Neurocritical Care Society 2012		American Epilepsy Society 2016
Stabilize patient (Airway, breathing, circulation, disability) Finger-stick glucose IV access and blood work Emergent AED administration: Benzodiazepines IV lorazepam (0.1 mg/kg up to 4 mg) IM midazolam (0.2 mg/kg up to 10 mg) IV diazepam (0.15 mg/kg up to 10 mg)	0–5 minutes	Stabilize patient (Airway, breathing, circulation, disability) Finger-stick glucose IV access and blood work
Urgent AED—5–10 minutes IV fosphenytoin/phenytoin (20 mg/kg) IV valproate sodium (20–40 mg/kg) IV phenobarbital (20 mg/kg) IV levetiracetam (1000–3000 mg) Midazolam infusion	5–20 minutes	Benzodiazepine administration IM midazolam (10 mg if >40 kg) IV lorazepam (0.1 mg/kg/dose, maximum 4 mg/dose) IV diazepam (0.15–0.2 mg/kg/dose, maximum 10 mg)
Refractory status epilepticus treatments—20–60 minutes—after second AED Midazolam (0.2 mg/kg; infusion rate of 2 mg/min) Pentobarbital (5–15 mg/kg, may give an additional 5–10 mg/kg; administer at an infusion rate ≤50 mg/min) Propofol (20 mcg/kg/min with 1–2 mg/kg loading dose) Thiopental (2–7 mg/kg; administer at an infusion rate ≤50 mg/min)	20–40 minutes	Second AED IV fosphenytoin (20 mg/kg, maximum 1500 mg) IV valproate sodium (40 mg/kg, maximum 3000 mg/dose) IV levetiracetam (60 mg/kg, maximum 4500 mg/dose) Or if none are available, IV phenobarbital (15 mg/kg)
	40–60 minutes	Third therapy phase Repeat second-line therapy or anesthetic doses of thiopental, midazolam, pentobarbital, or propofol with continuous EEG monitoring



Table 5. SE in selected electroclinical syndromes according to age

SE occurring in neonatal and infantile-onset epilepsy syndromes Tonic status (e.g., in Ohtahara syndrome or West syndrome) Myoclonic status in Dravet syndrome Focal status Febrile SE
SE occurring mainly in childhood and adolescence Autonomic SE in early-onset benign childhood occipital epilepsy (Panayiotopoulos syndrome) NCSE in specific childhood epilepsy syndromes and etiologies (e.g., Ring chromosome 20 and other karyotype abnormalities, Angelman syndrome, epilepsy with myoclonic-atonic seizures, other childhood myoclonic encephalopathies; see Appendices 1–3) Tonic status in Lennox-Gastaut syndrome Myoclonic status in progressive myoclonus epilepsies Electrical status epilepticus in slow wave sleep (ESES) Aphasic status in Landau-Kleffner syndrome
SE occurring mainly in adolescence and adulthood Myoclonic status in juvenile myoclonic epilepsy Absence status in juvenile absence epilepsy Myoclonic status in Down syndrome
SE occurring mainly in the elderly Myoclonic status in Alzheimer's disease Nonconvulsive status epilepticus in Creutzfeldt-Jakob disease De novo (or relapsing) absence status of later life

These forms of SE may be encountered prevalently in some age groups, but not exclusively.

Table 4. Etiology of status epilepticus

Known (i.e., symptomatic) Acute (e.g., stroke, intoxication, malaria, encephalitis, etc.) Remote (e.g., posttraumatic, postencephalitic, poststroke, etc.) Progressive (e.g., brain tumor, Lafora's disease and other PMEs, dementias) SE in defined electroclinical syndromes
Unknown (i.e., cryptogenic)



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

AXIS 3 : EEG correlates

Currently there are no evidence-based EEG criteria for SE. Based on large descriptive series and consensus panels from 5 papers

terminology to describe EEG patterns in SE:

- 1 **Location:** generalized (including bilateral synchronous patterns), lateralized, bilateral independent, multifocal.
- 2 **Name of the pattern:** Periodic discharges, rhythmic delta activity or spike-and-wave/sharp-and-wave plus subtypes.
- 3 **Morphology:** sharpness, number of phases (e.g., triphasic morphology), absolute and relative amplitude, polarity.
- 4 **Time-related features:** prevalence, frequency, duration, daily pattern duration and index, onset (sudden vs. gradual), and dynamics (evolving, fluctuating, or static).
- 5 **Modulation:** stimulus-induced vs. spontaneous.
- 6 **Effect of intervention** (medication) on EEG.

Epilepsia, 56(10):1515–1523, 2015

ACNS Standardized Critical Care EEG Terminology (2012)



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Overview

Standardized terminology of periodic and rhythmic EEG patterns in the critically ill has been proposed by the ACNS and is reproduced in outline form below. This terminology is designed for research purposes, not for clinical use. Terms were chosen to avoid clinical connotations and to ensure adequate inter-rater reliability.

The full text of the article: *American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2012 version* can be found at the ACNS website, here: <http://www.acns.org/pdf/guidelines/Guideline-14.pdf>

Rhythmic or periodic patterns

All terms consist of main term # 1 followed by #2, with modifiers added as appropriate.

Main Term 1

- Generalized (G)
- Lateralized (L)
- Bilateral Independent (BI)
- Multifocal (Mf)

Main Term 2

- Periodic Discharges (PD)
- Rhythmic Delta Activity (RDA)
- Spike or Sharp and Wave (SW)

Modifiers

- Prevalence
- Duration
- Frequency
- Number of phases
- Sharpness
- Amplitude
- Polarity
- Stimulus-Inducing (SI)
- Evolving OR Fluctuating
- Plus (+)

Minor Modifiers

- Quasi-
- Sudden OR gradual onset
- Triphasic morphology
- A-P or P-A lag

Sporadic epileptiform

- Abundant
- Frequent
- Occasional
- Rare

Background EEG

Symmetry

Posterior Dominant Rhythm

Predominant frequency

Anterior-Posterior Gradient

Variability

Reactivity

Voltage

Stage II sleep transients

Continuity

- Continuous
- Nearly continuous
- Discontinuous
- Burst attenuation / suppression
- Suppression



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Proposed nomenclature

A. Rhythmic or periodic patterns

B. Minimal time epochs to be reported. Documented separately

- First 30 minutes
- Each 24 hour period

C. Quantification and categorization of sporadic (non-rhythmic and non-periodic) epileptiform discharges (includes sharp waves and spikes)

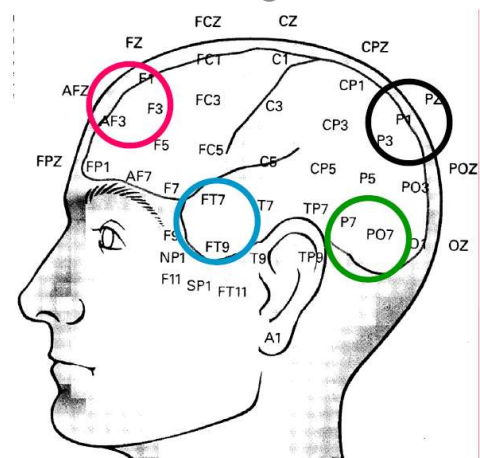
D. Background EEG



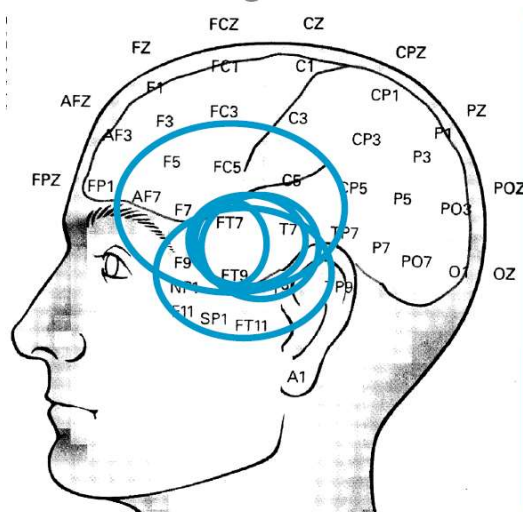
สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

AXIS 3 : EEG correlates

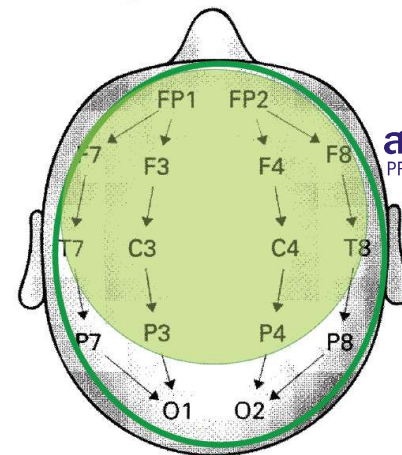
Multiregional



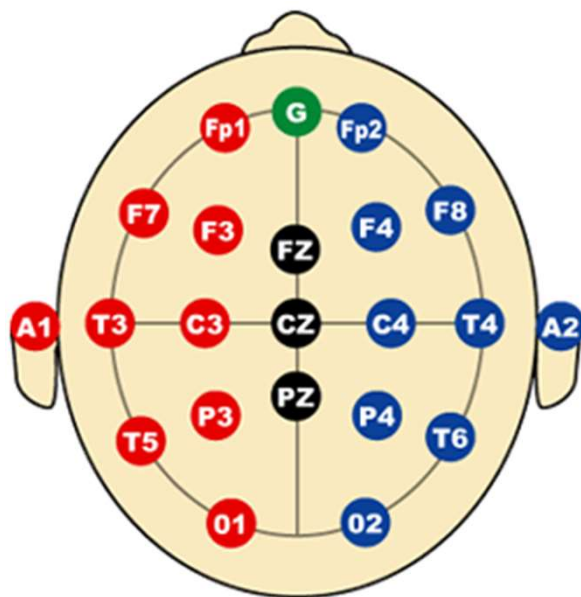
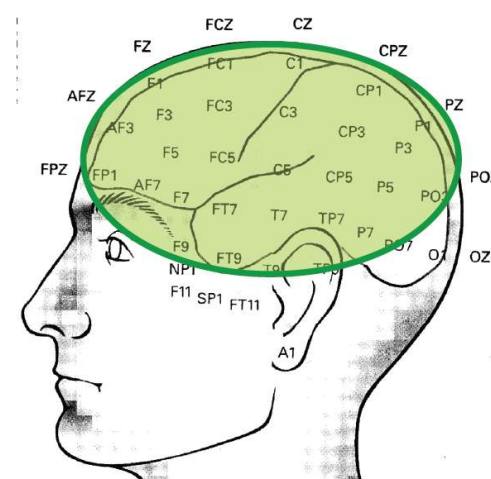
Regional



Generalized



Lateralized



Location



Main Term 2 (Name of the pattern)

• **Rhythmic** = repetition of a waveform with relatively uniform morphology and duration and without an interval between consecutive waveforms. Duration of one cycle (the period) should vary by <50% from the duration of the subsequent cycle for the majority (>50%) of cycle pairs to qualify as a rhythmic pattern.

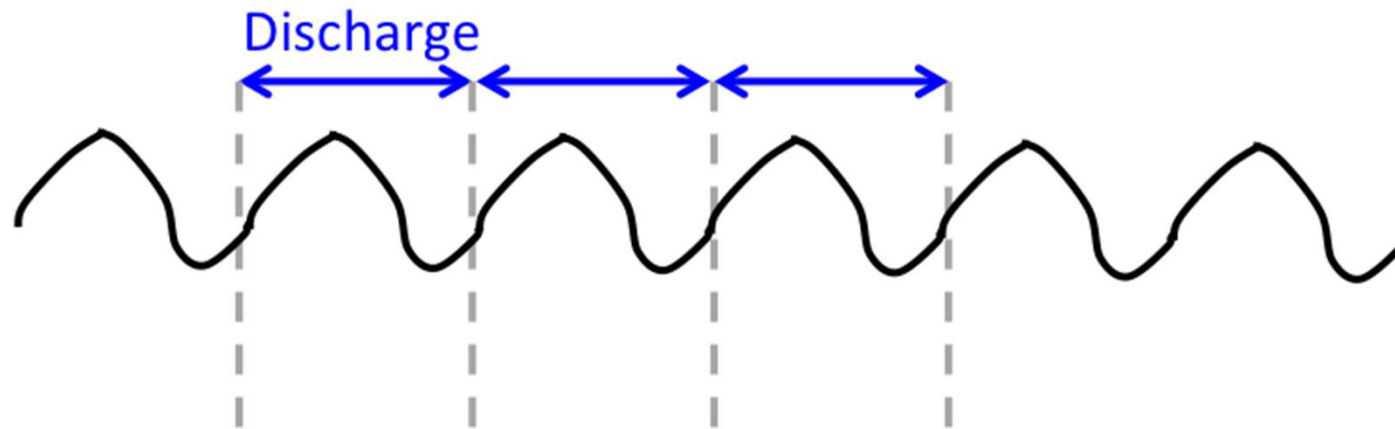


• **Periodic discharges** = repeating waveforms/discharges with (relatively) uniform morphology at nearly regular intervals. Applies *only* to **single discharges** (must have ≤ 3 phases [i.e. ≤ 2 baseline crossings] or any discharge lasting ≤ 0.5 sec regardless of number of phases) and *not* to **bursts** (discharges lasting > 0.5 sec and having ≥ 4 phases [i.e. ≥ 3 baseline crossings]). “Nearly regular intervals” = cycle length (period) varying by $< 50\%$ from one cycle to the next in most ($> 50\%$) cycle pairs.

Main term: Rhythmic



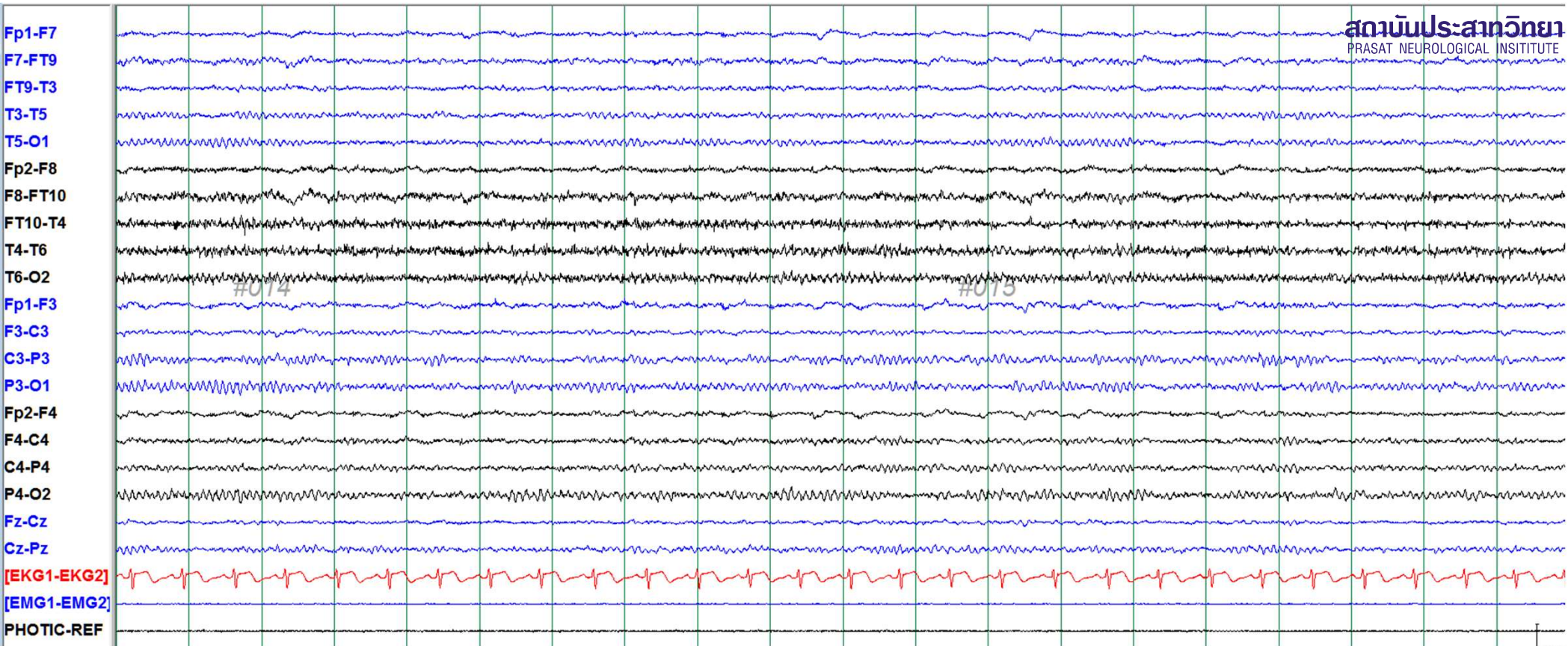
สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



No interdischarge interval



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



Main Term: Definitions



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

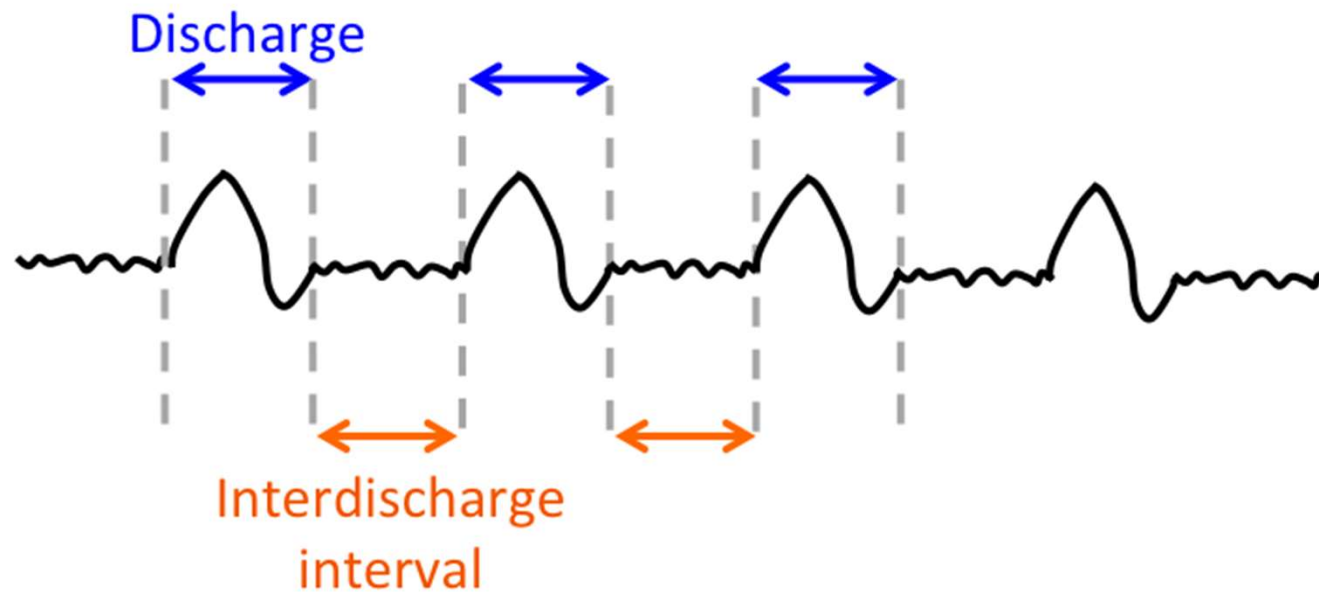
• **Periodic discharges**= repeating waveforms/discharges with (relatively) uniform morphology at nearly regular intervals. Applies *only* to **single discharges** (must have ≤ 3 phases [i.e. ≤ 2 baseline crossings] or any discharge lasting ≤ 0.5 sec regardless of number of phases) and *not* to **bursts** (discharges lasting > 0.5 sec and having ≥ 4 phases [i.e. ≥ 3 baseline crossings]). “Nearly regular intervals” = cycle length (period) varying by $< 50\%$ from one cycle to the next in most ($> 50\%$) cycle pairs.

• **Rhythmic** = repetition of a waveform with relatively uniform morphology and duration and without an interval between consecutive waveforms. Duration of one cycle (the period) should vary by $< 50\%$ from the duration of the subsequent cycle for the majority ($> 50\%$) of cycle pairs to qualify as a rhythmic pattern.

Main term : Periodic



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE





สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



Periodic discharges= repeating waveforms/discharges with (relatively) uniform morphology at nearly regular intervals.

Applies *only* to **single discharges** (must have ≤ 3 phases [i.e. ≤ 2 baseline crossings] or any discharge lasting ≤ 0.5 sec regardless of number of phases) and *not* to **bursts** (discharges lasting > 0.5 sec and having ≥ 4 phases [i.e. ≥ 3 baseline crossings]). “Nearly regular intervals” = cycle length (period) varying by $< 50\%$ from one cycle to the next in most $> 50\%$ cycle pairs.

IIC EEG patterns

- **Rhythmic delta activity (RDA):** LRDA, GRDA
- **Periodic discharges (PDs):** LPD, GPD, BiPD, MfPD
- **Spike or sharp wave discharges (SW)**



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



Table 1

Old and new terms of EEG patterns in the patients with critical illness, modified according to the 2012 version of the American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology [2].

Commonly used terminology	New terminology
Triphasic waves (TWs)	Continuous 2/s GPDs with triphasic morphology
Periodic lateralized epileptiform discharges (PLEDs)	Lateralized periodic discharges (LPDs)
Bilateral periodic epileptiform discharges (BiPLEDs)	Bilateral periodic discharges (BPDs)
Generalized periodic epileptiform discharges (GPEDs)	Generalized periodic discharges (PDs)
Frontal intermittent rhythmic delta activity (FIRDA)	Occasional frontally predominant brief 2/s generalized rhythmic delta activity
Stimulus-induced rhythmic, periodic, or ictal discharges (SIRPIDs) with focal evolving rhythmic delta activity	Stimulus-induced-evolving lateralized rhythmic delta activity (SI-evolving LRDA)
Lateralized seizure, delta frequency range	Evolving lateralized rhythmic delta activity (LRDA)
Semirhythmic delta	Quasi RDA
Coma with lateralized epileptiform discharges (coma-LEDs) [14]	Coma with lateralized periodic discharges (coma-LPDs)
Coma with generalized epileptiform discharges (coma-GEDs)	Coma with generalized periodic discharges (coma-GPDs)



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

TABLE 1. New Terms for Older Terms

OLD Term		NEW Term
Triphasic waves, most of record	=	continuous 2/s GPDs (with triphasic morphology)
PLEDs	=	LPDs
BIPLEDs	=	BIPDs
GPEDs/PEDs	=	GPDs
FIRDA	=	Occasional frontally predominant brief 2/s GRDA (if 1-10% of record)
PLEDs +	=	LPDs+
SIRPIDs* w/ focal evolving RDA	=	SI-Evolving LRDA
Lateralized seizure, delta frequency	=	Evolving LRDA
Semirhythmic delta	=	Quasi-RDA

*SIRPIDs = stimulus-induced rhythmic, periodic or ictal discharges.

Ictal- Interictal Continuum



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

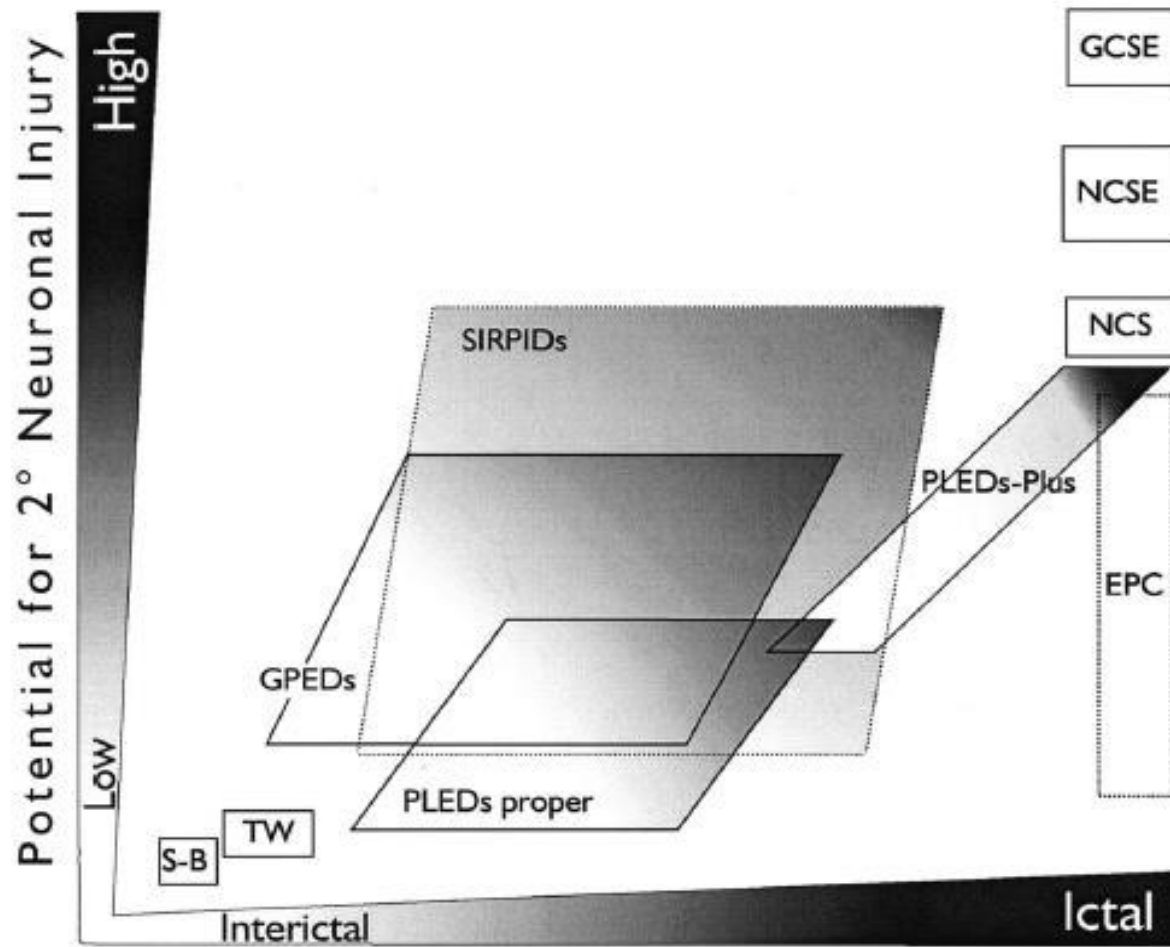


Etiology :
clinical evaluation / Imagine
/ Laboratory test

Treatment :
Benzodiazepine /
Antiepileptic

Outcomes : clinical and
neurophysiology improvement /
worsening

The Ictal-Interictal-Injury Continuum



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Chong DJ and Hirsch LJ et al; J Clin Neurophysiol 2005

AS in IGE
Late AS de novo
Atypical AS

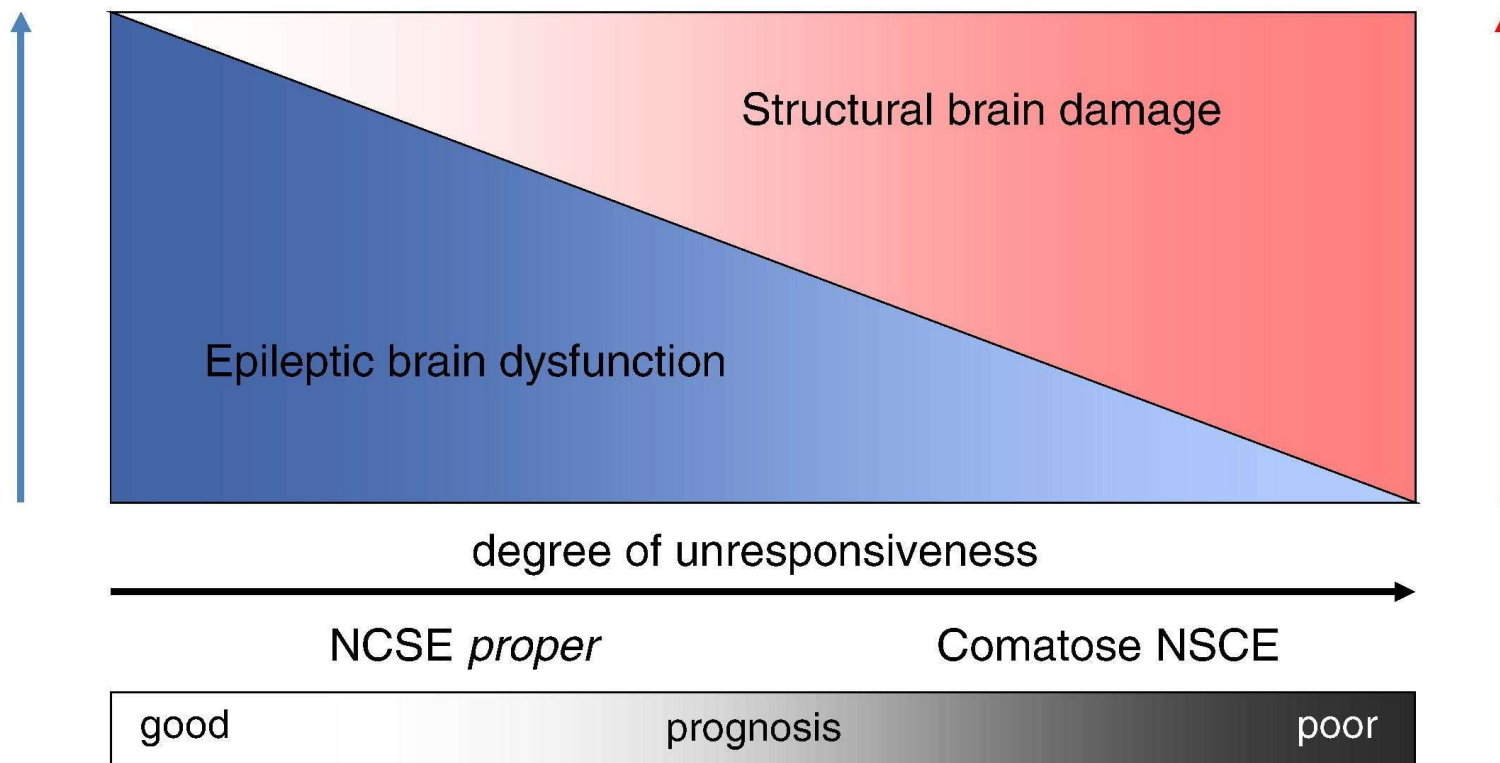
Focal SE with impaired consciousness,
Aura continua,
Status aphasicus

Acute symptomatic focal SE +/- EPC
Subtle SE

Coma with GPD
Coma with LPD



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



Trinka U and Leitinger M; *Epilepsy & Behav* 2015

Coma and PLEDs were predictors of Delayed time to first seizure



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Table 4 Other cEEG findings in patients with seizures on cEEG, n = 110

Findings	Seizures on cEEG monitoring			Time of cEEG monitoring to first seizure >24 h		
	Yes, n = 110	No, n = 460	<i>p</i>	Yes, n = 14	No, n = 96	<i>p</i>
Periodic epileptiform findings						
Any	49 (45)	82 (20)	<0.001	9 (64)	40 (42)	NS
PLED	44 (40)	46 (11)	<0.001	9 (64)	35 (37)	0.047
GPED	19 (17)	24 (6)	<0.001	2 (14)	17 (18)	NS
BiPLED	7 (6)	13 (3)	NS	0 (0)	7 (7)	NS
Triphasic waves	4 (4)	25 (6)	NS	0 (0)	4 (4)	NS
Frontal intermittent rhythmic delta activity	11 (10)	35 (9)	NS	2 (14)	9 (10)	NS
Suppression burst	35 (32)	13 (3)	<0.001	4 (29)	31 (32)	NS

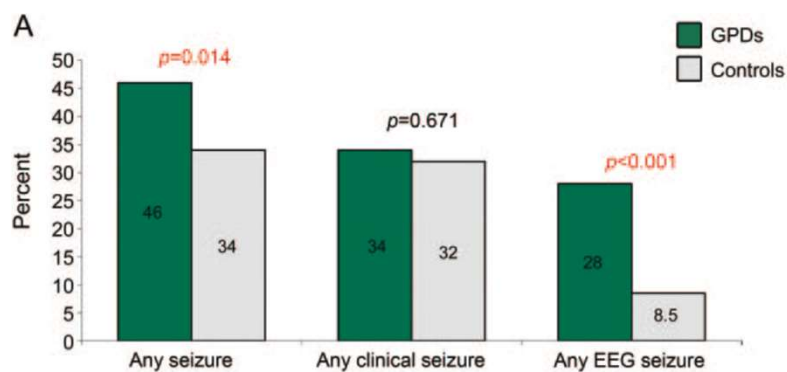
Data are given as n (%). Some patients had multiple EEG patterns documented on continuous EEG (cEEG). The observed EEG findings do not have a constant temporal relationship, and seizures may precede other EEG findings in individual patients or vice versa.

PLED = periodic lateralized epileptiform discharges; GPED = generalized PED; BiPLED = bilateral PLED.

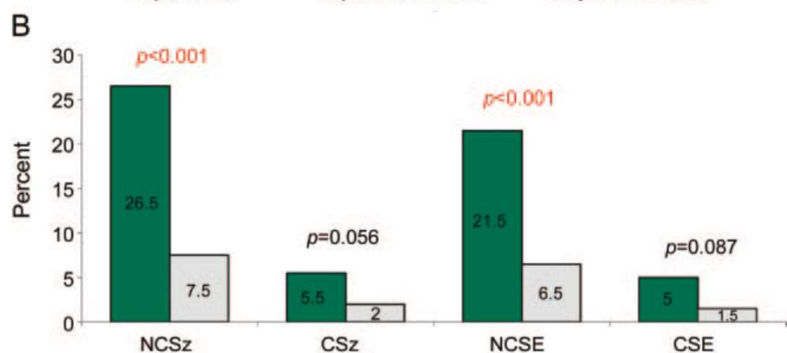
Hirsch et al 2012



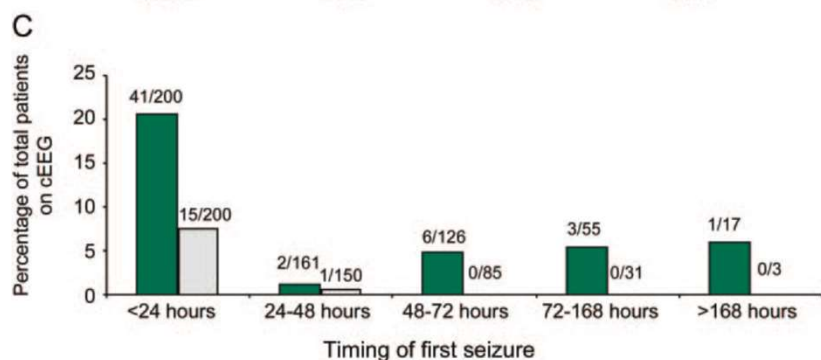
สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



(A) Comparison of seizure occurrence at any time in patients with GPDs vs controls (%).



(B) Comparison of seizures during continuous EEG monitoring (cEEG) in patients with GPDs vs controls (%)

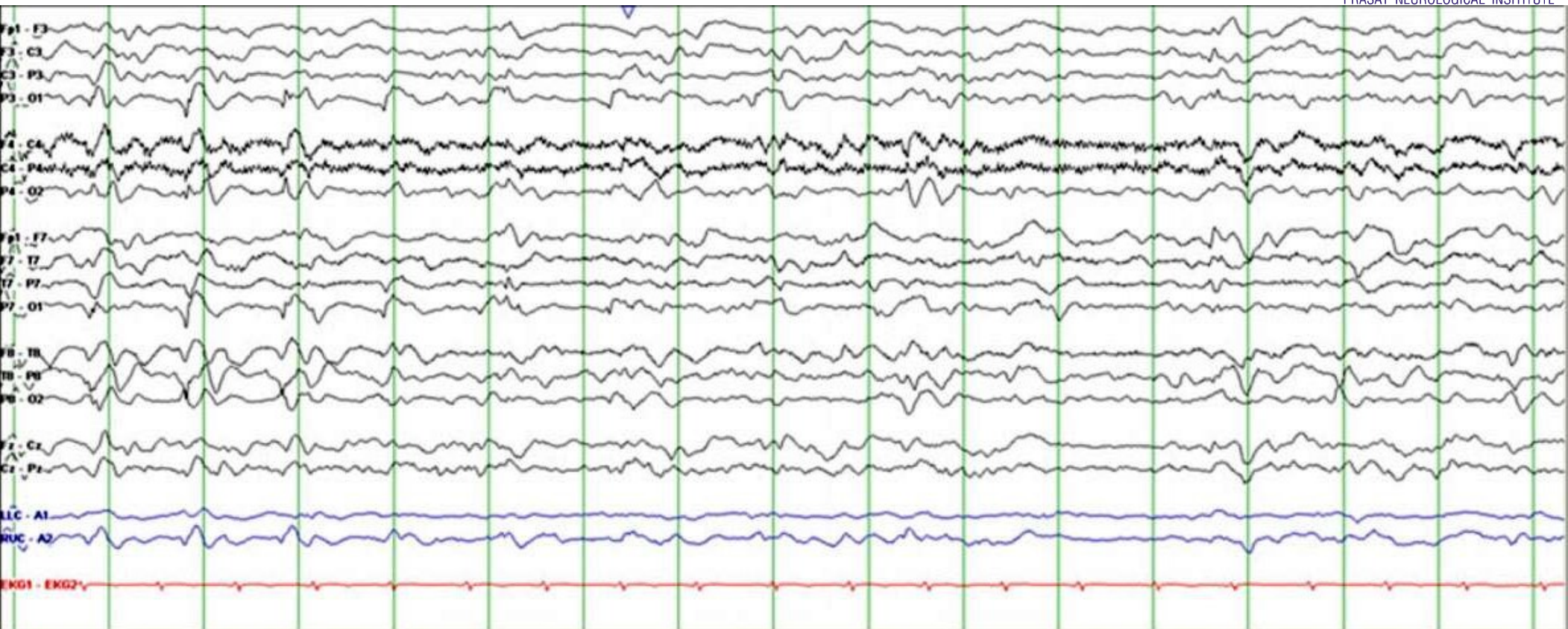


(C) Timing of first recorded seizure in patients with GPDs vs controls.

[Neurology](#). 2012 Nov 6; 79(19): 1951–1960.



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE



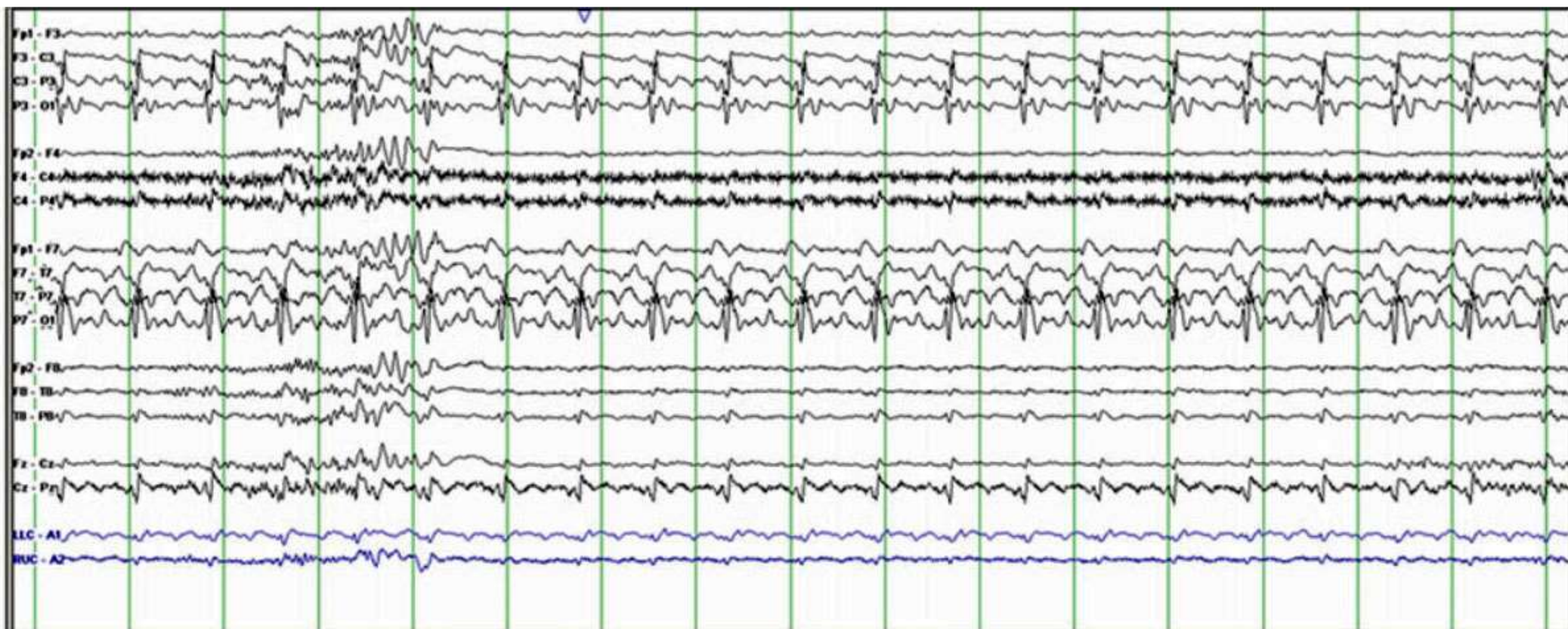


สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE





สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE





สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Ictal EEG patterns and criteria for nonconvulsive status epilepticus

EEG Diagnosis of NCSE



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

2013:

Salzburg Consensus Criteria for diagnosis of Non-Convulsive Status Epilepticus (SCNC) were proposed at the 4th London-Innsbruck Colloquium on status epilepticus in Salzburg

In Addition, 2012:

American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology, 2012 version (ACNS criteria)



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Epilepsia, 54(Suppl. 6):28–29, 2013
doi: 10.1111/epi.12270

STATUS EPILEPTICUS 2013

Unified EEG terminology and criteria for nonconvulsive status epilepticus

*†Sandor Beniczky, ‡Lawrence J. Hirsch, §Peter W. Kaplan, ¶Roni Pressler,
**Gerhard Bauer, ††‡‡Harald Aurlen, ††‡‡Jan C. Brøgger, and §§Eugen Trinka

*Department of Clinical Neurophysiology, Danish Epilepsy Center, Dianalund, Denmark; †University of Aarhus, Aarhus, Denmark; ‡Department of Neurology, Yale University School of Medicine, New Haven, Connecticut, U.S.A.; §Department of Neurology, The Johns Hopkins Bayview Medical Center, Baltimore, Maryland, U.S.A.; ¶Great Ormond Street Hospital for Children, NHS Foundation Trust, London, United Kingdom; **Department of Neurology, Medical University of Innsbruck, Innsbruck, Austria; ††Department of Neurology, Haukeland University Hospital, Bergen, Norway; ‡‡Department of Clinical Medicine, University of Bergen, Bergen, Norway; and §§Department of Neurology, Paracelsus Medical University, Salzburg, Austria

Working Clinical Criteria for Nonconvulsive Status Epilepticus



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Patients without known epileptic encephalopathy

-Epileptiform Discharges > 2.5 Hz

-Epileptiform Discharges ≤ 2.5 Hz or rhythmic delta/theta activity (>0.5 Hz)

AND one of the following:

- EEG and clinical improvement after IV AED
- Subtle clinical ictal phenomena during the EEG patterns mentioned
- Typical **spatiotemporal evolution**

Working Clinical Criteria for Nonconvulsive Status Epilepticus



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

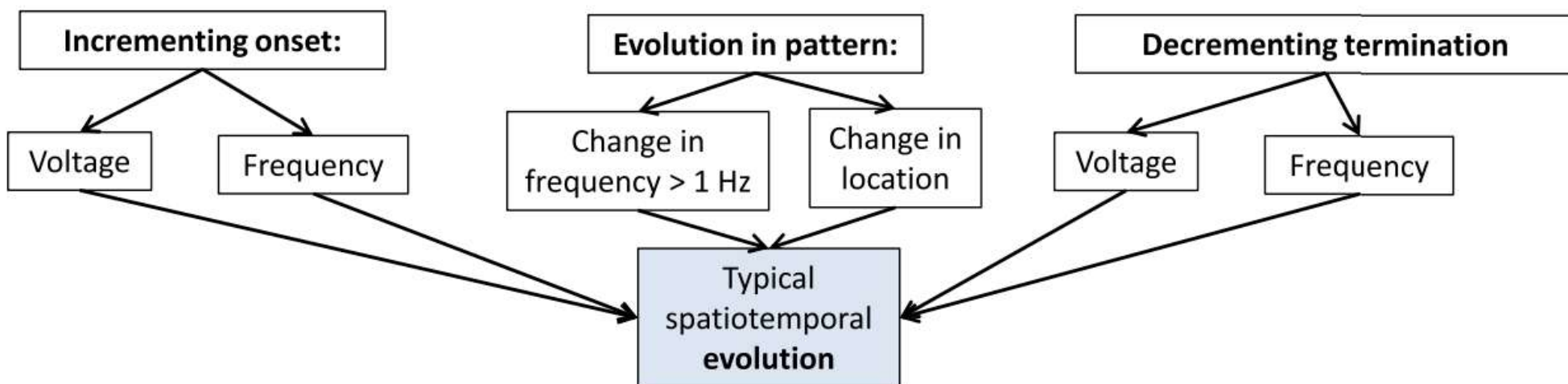
Patients with known epileptic encephalopathy

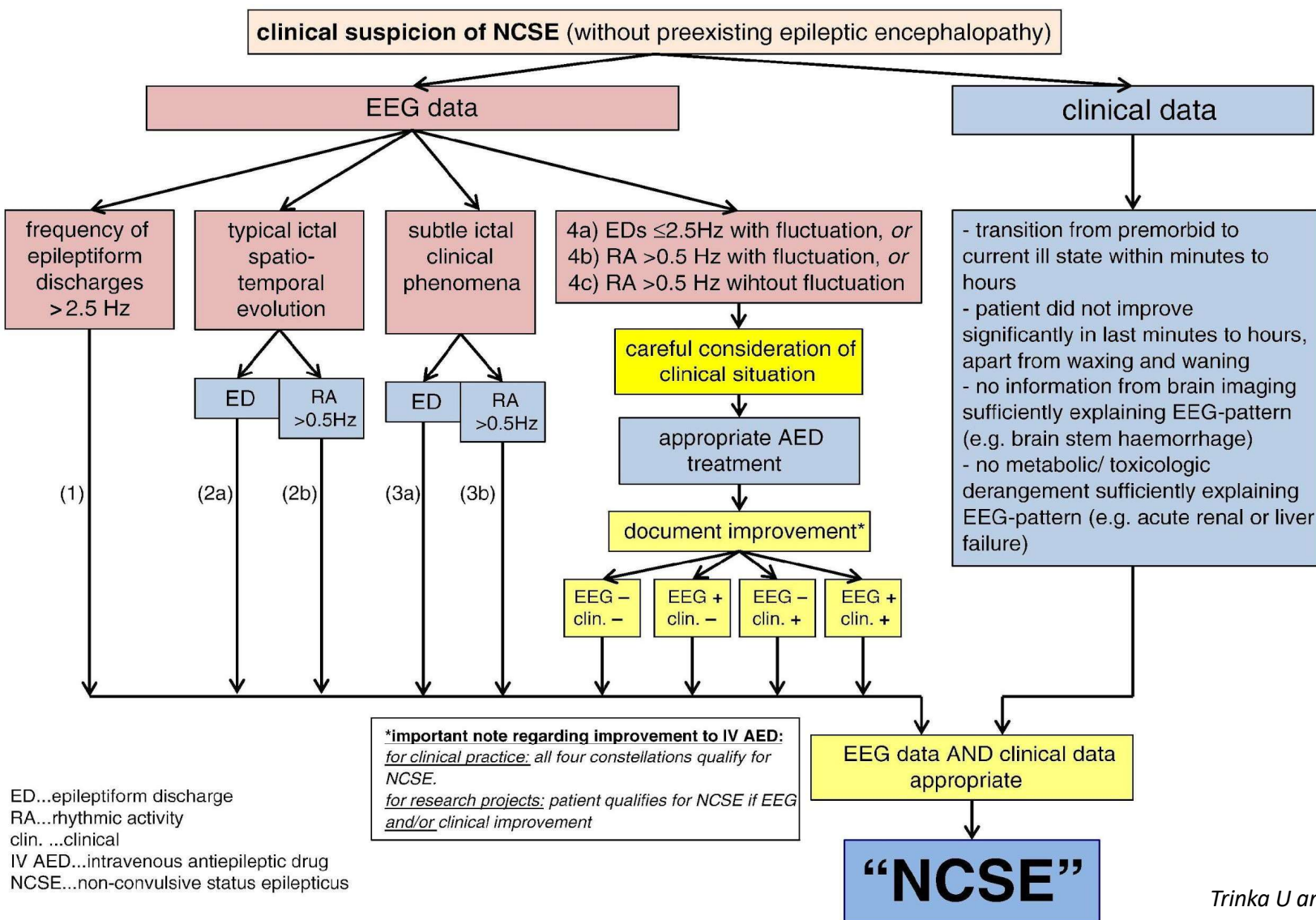
West, Landau/Kleffner, Otahara, Early Myoclonic infancy, Dravet, Lennox-Gastaut, Doose)

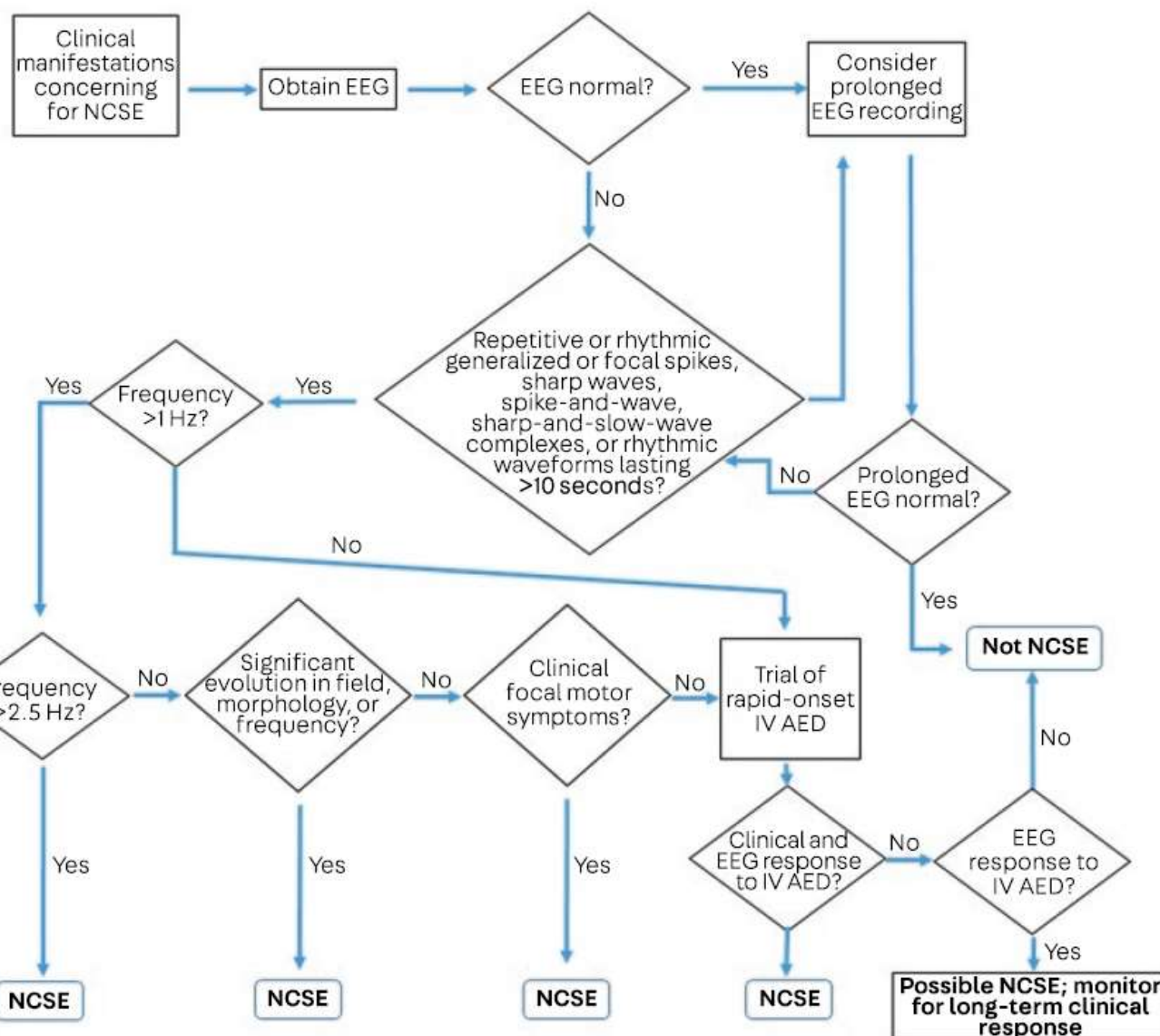
- Increase in prominence or frequency of the features mentioned above, when compared to baseline **with observable change in clinical state**
- Improvement of clinical and EEG features with IV AEDs
- -Epileptiform Discharges > 2.5 Hz
- -Epileptiform Discharges ≤ 2.5 Hz or rhythmic delta/theta activity (>0.5 Hz)



EEG: typical ictal spatiotemporal evolution









สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

5 Modulation: (SIRPIDs) Stimulus-induced rhythmic, periodic, or ictal discharges

- induced by alerting stimuli such as auditory stimuli, sternal rub, examination, suctioning, turning, and other patient-care activities
- commonly elicited by stimulation in critically ill (stuporous or comatose), encephalopathic patients
- Pathophysiology of SIRPIDs is unknown
- The relationship between clinical seizures and SIRPIDs is unclear, although some association is found between SIRPIDs and clinical status epilepticus



6 Effect of intervention (medication)

EEG patterns and their correlation with NCS/NCSE

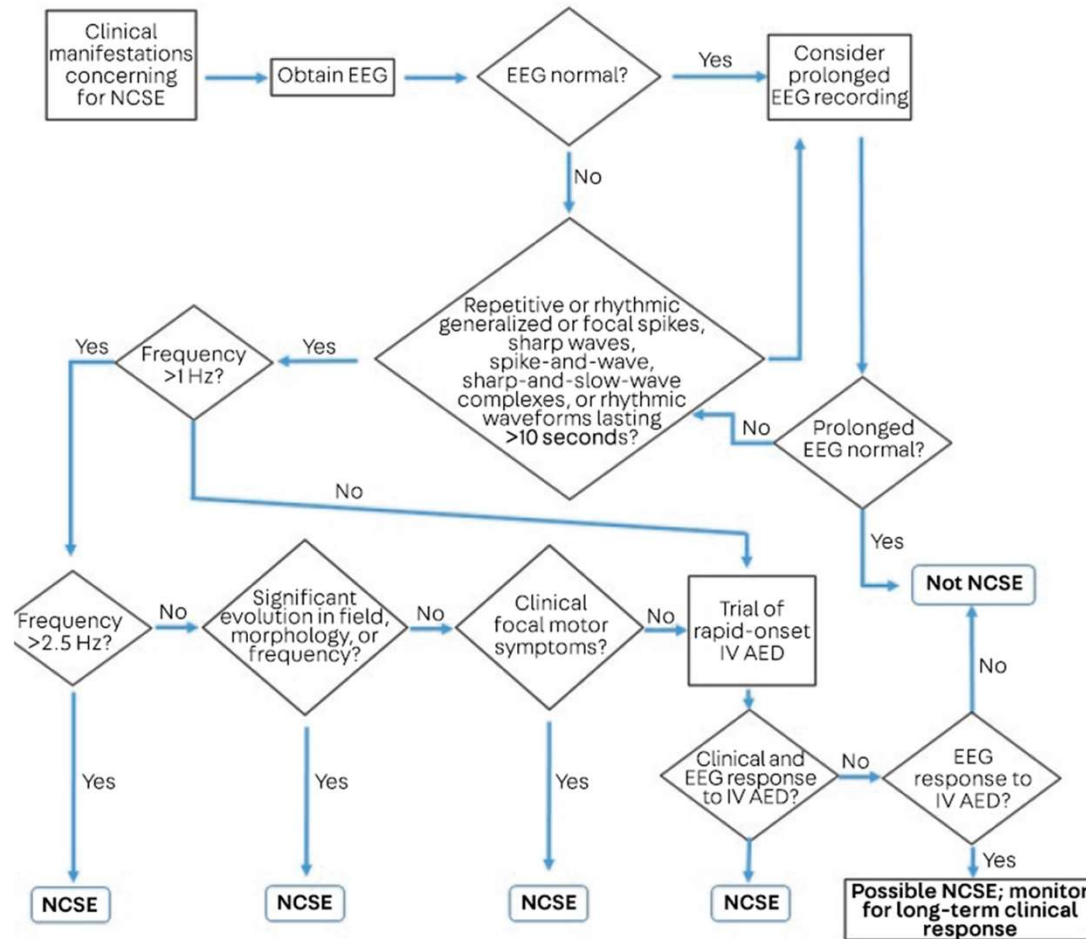
EEG patterns	Do NOT reflect NCSE <u>NOT TREATED</u>	Reflect NCSE Should be <u>TREATED</u>	<u>BORDERLINE</u> Of NCSE in coma One additional criteria is needed to diagnose NCSE
<ul style="list-style-type: none"> ❖ Classical coma pattern - Diffuse polymorphic delta activity - Spindle coma - Alpha/theta coma - Low voltage - Burst suppression 	<ul style="list-style-type: none"> × × × × × 		
<ul style="list-style-type: none"> ❖ Ictal patterns with typical spatiotemporal evolution ❖ Epileptiform discharges > 2.5 Hz in comatose patients 		<ul style="list-style-type: none"> × × 	
<ul style="list-style-type: none"> ❖ GPDs or LPDs < 2.5 Hz ❖ Rhythmic discharges (RDs) > 0.5 Hz 			<ul style="list-style-type: none"> × ×

Review Example

Patient with fever and unresponsive



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE





Patient with fever and unresponsive

สถาบันประสาทวิทยา
PRAVAT NEUROLOGICAL INSTITUTE

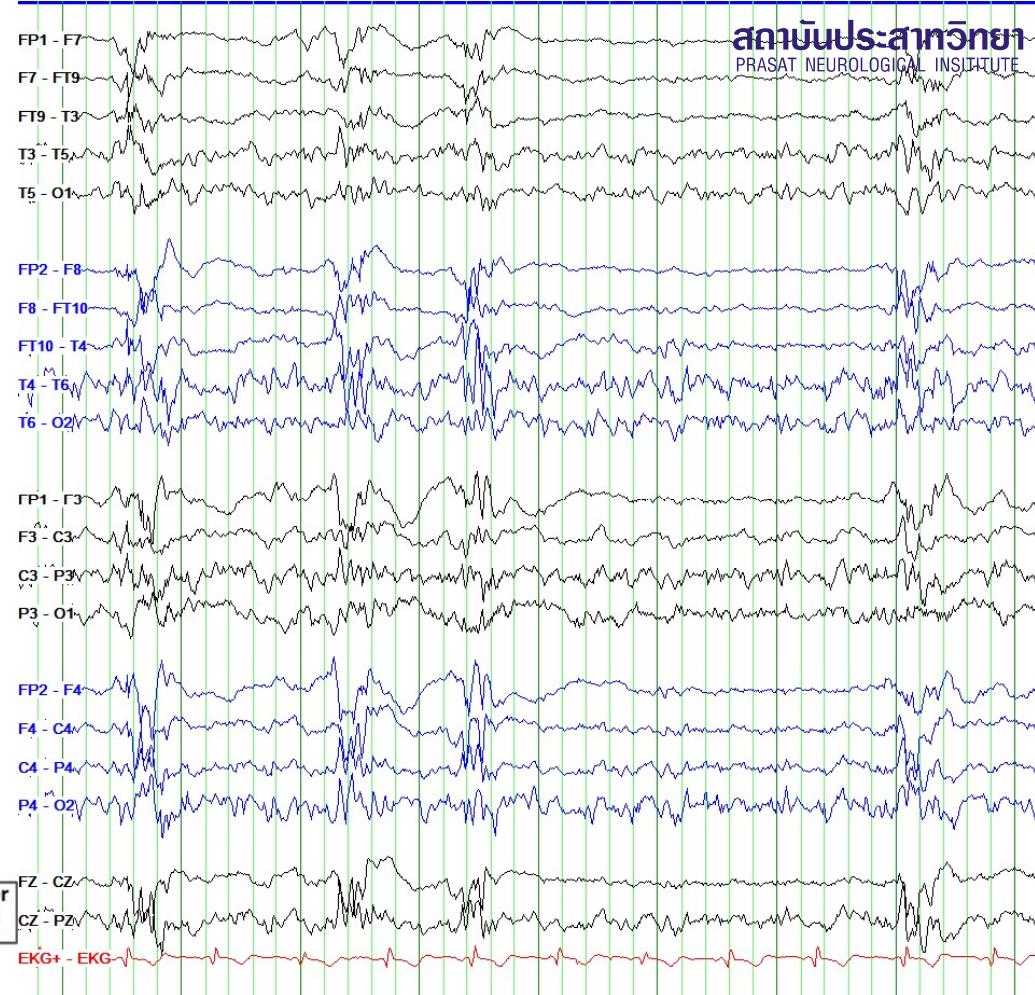
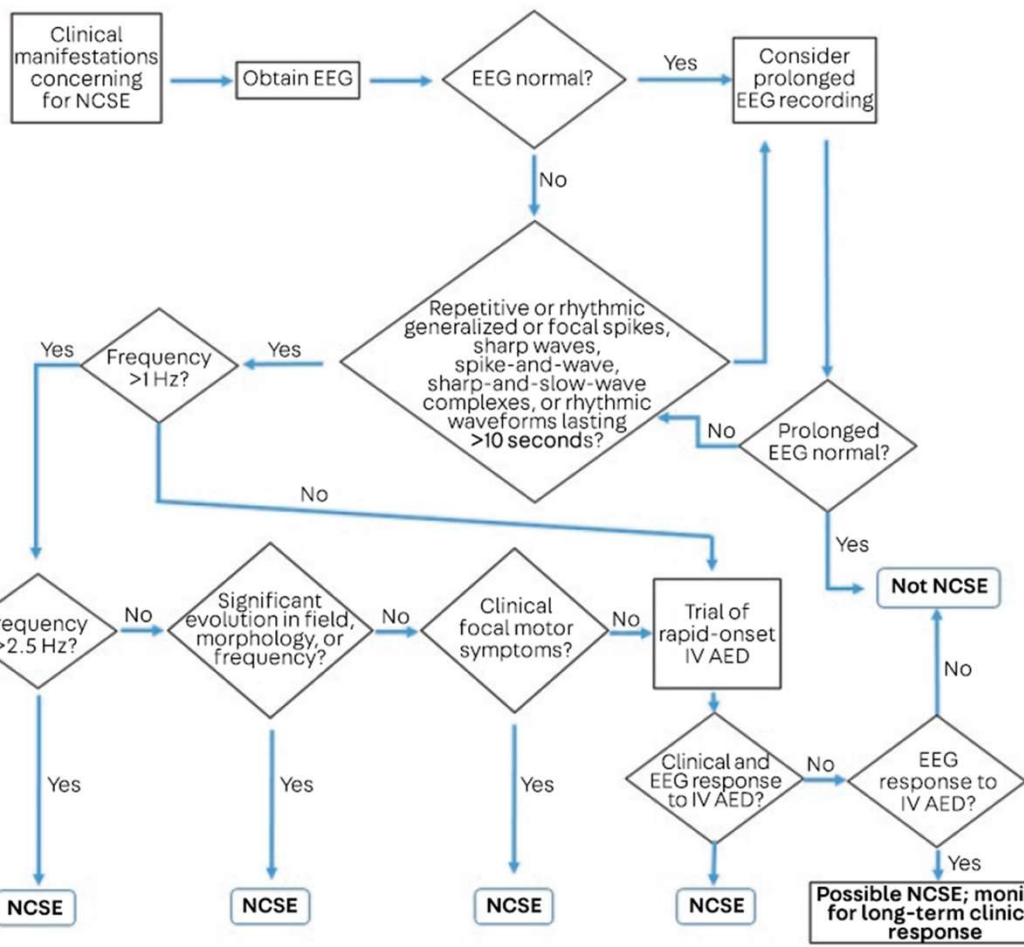




สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Review Example

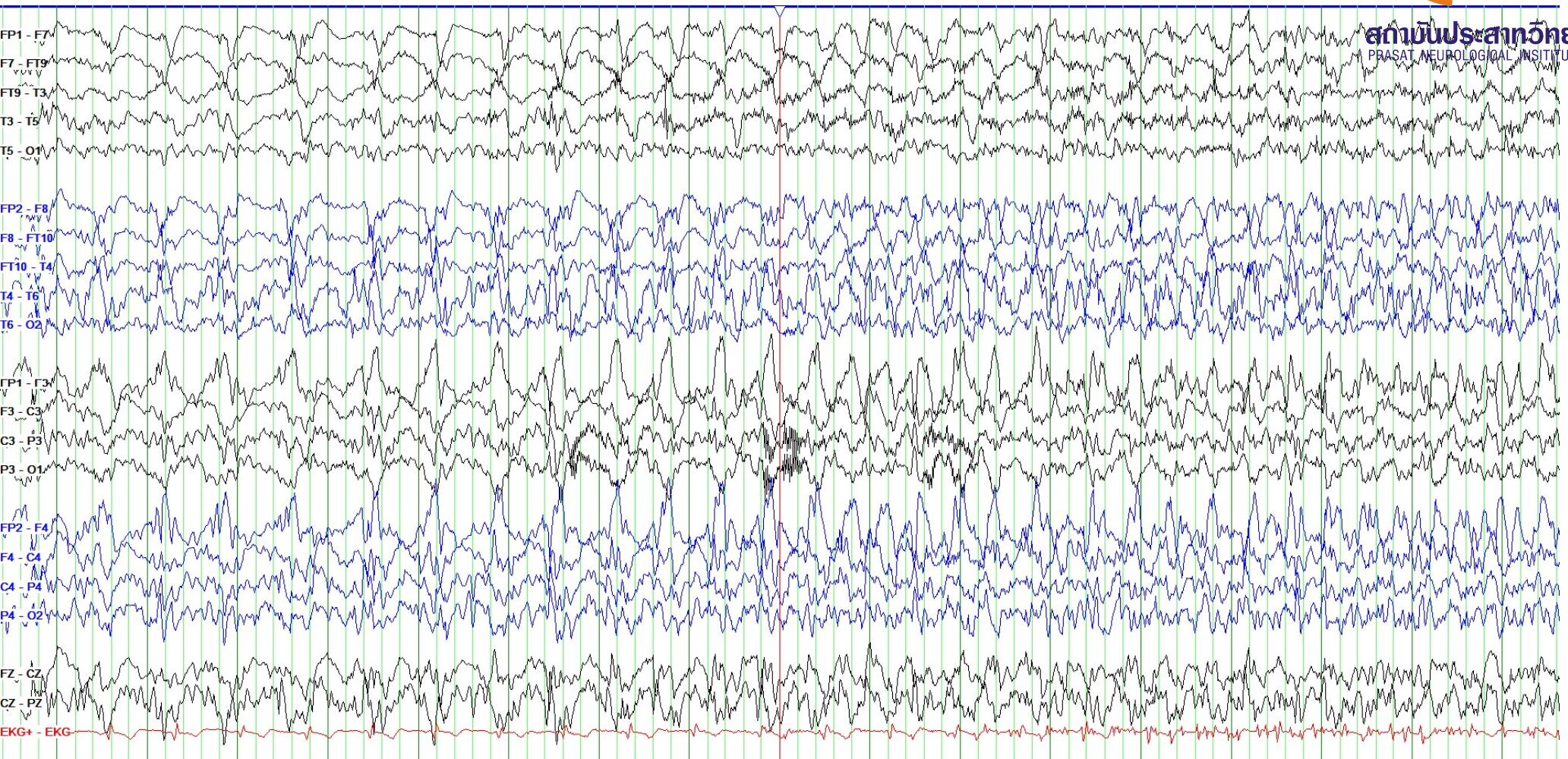
Patient with fever and unresponsive



Patient with fever and unresponsive



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

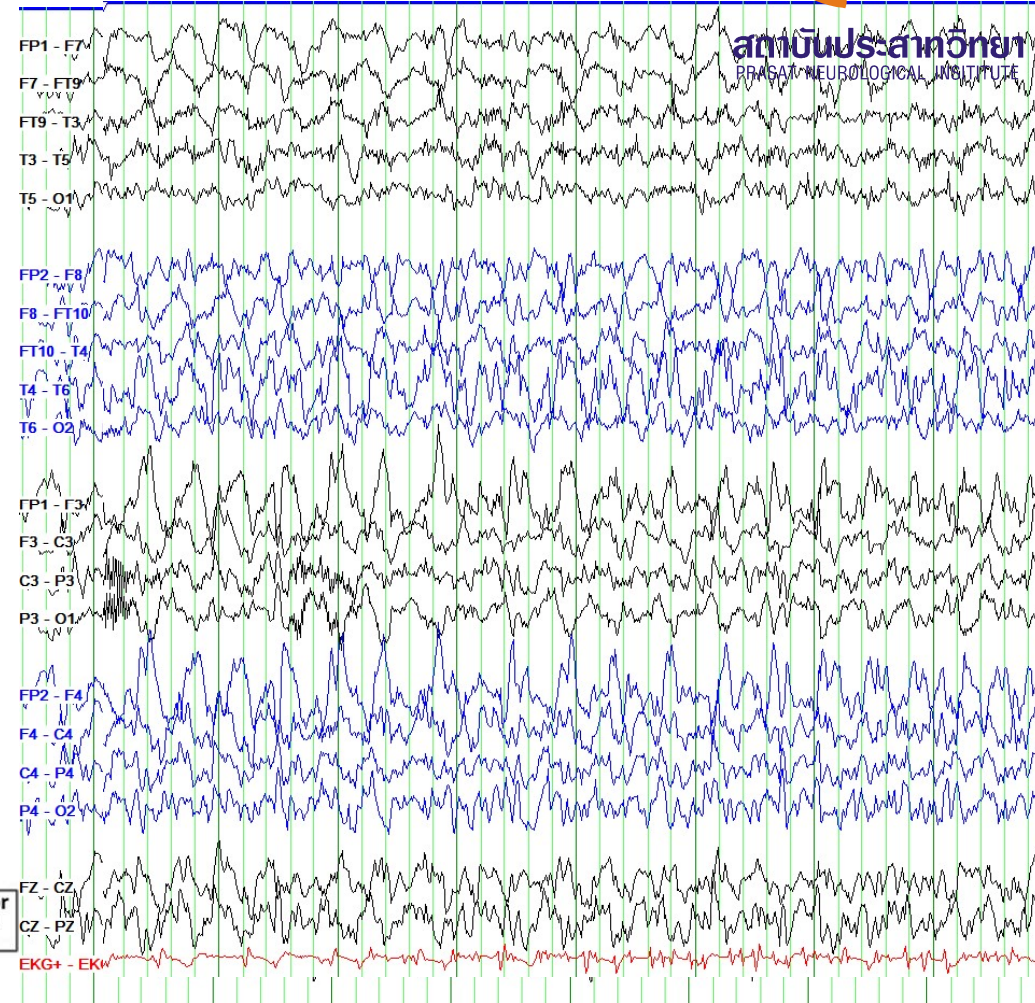
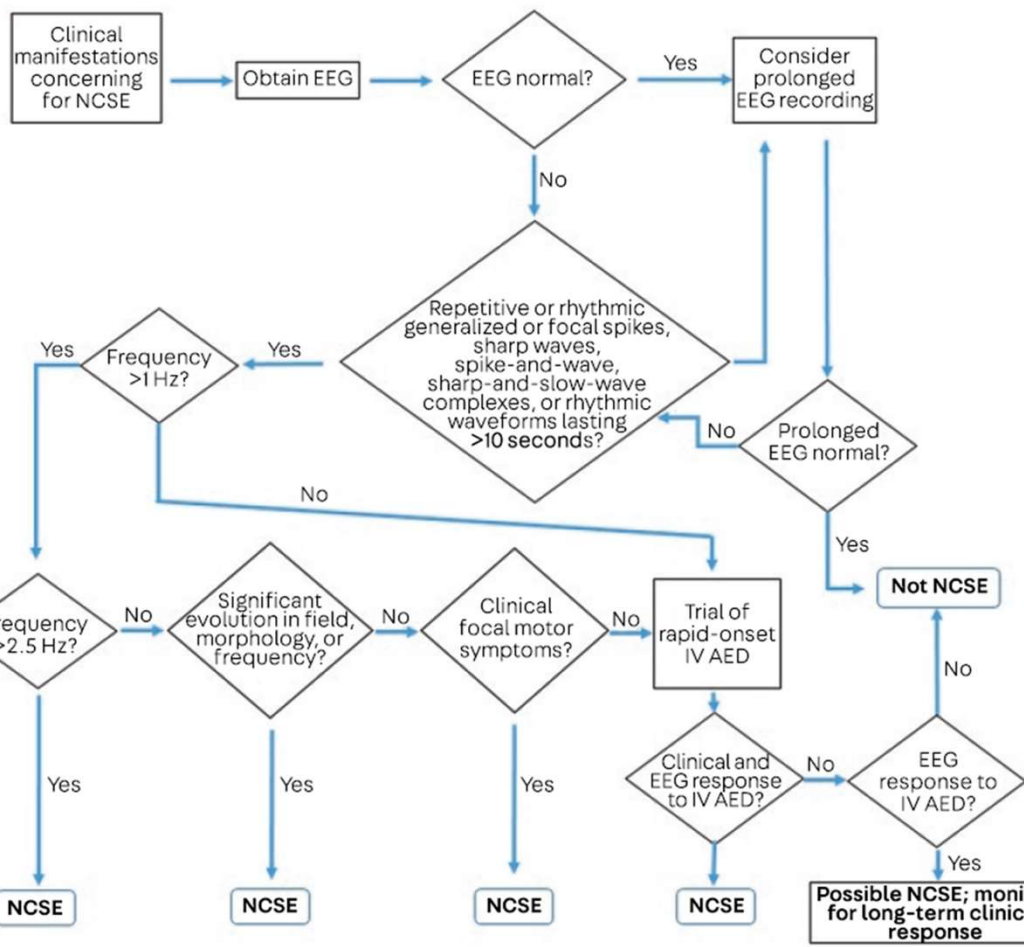




prasat neurological institute

Review Example

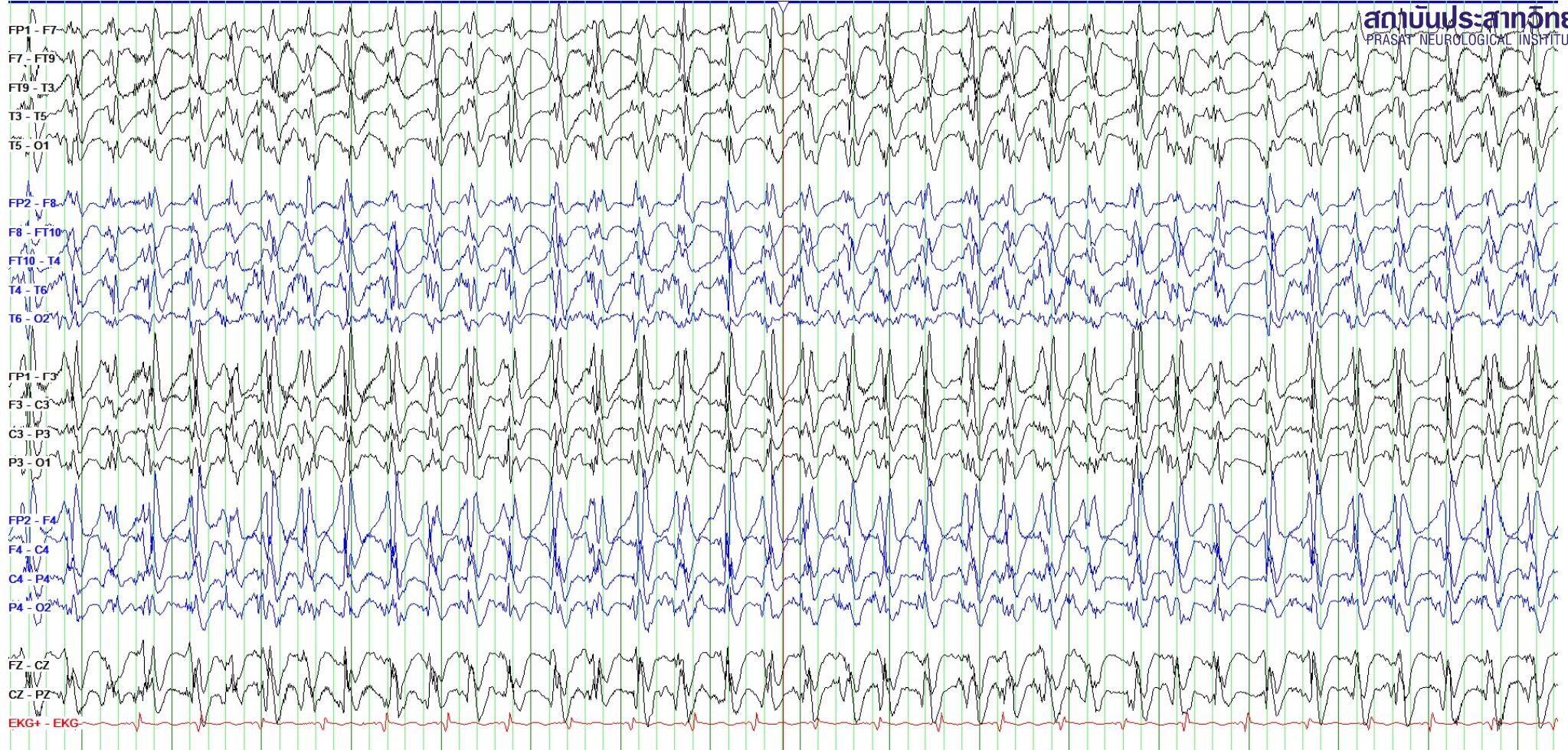
Patient with fever and unresponsive



Patient with fever and unresponsive



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

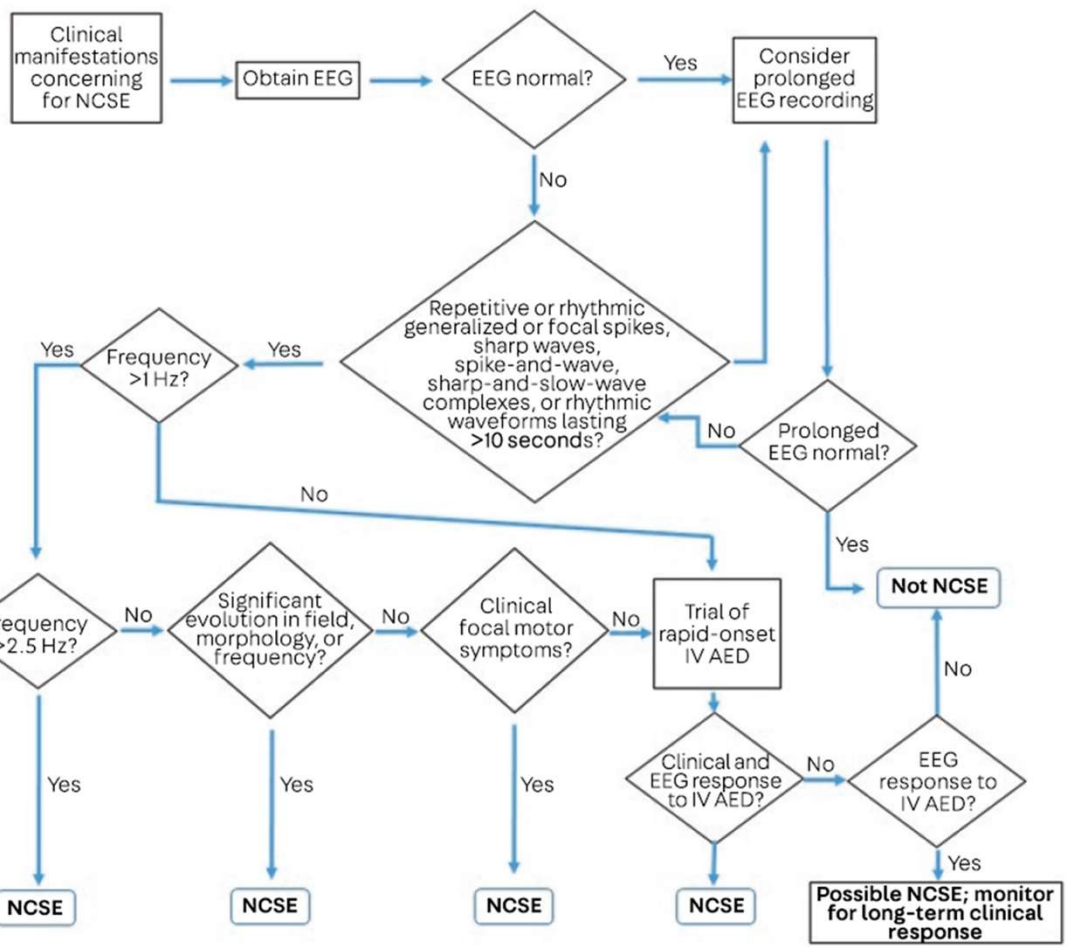




สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Review Example

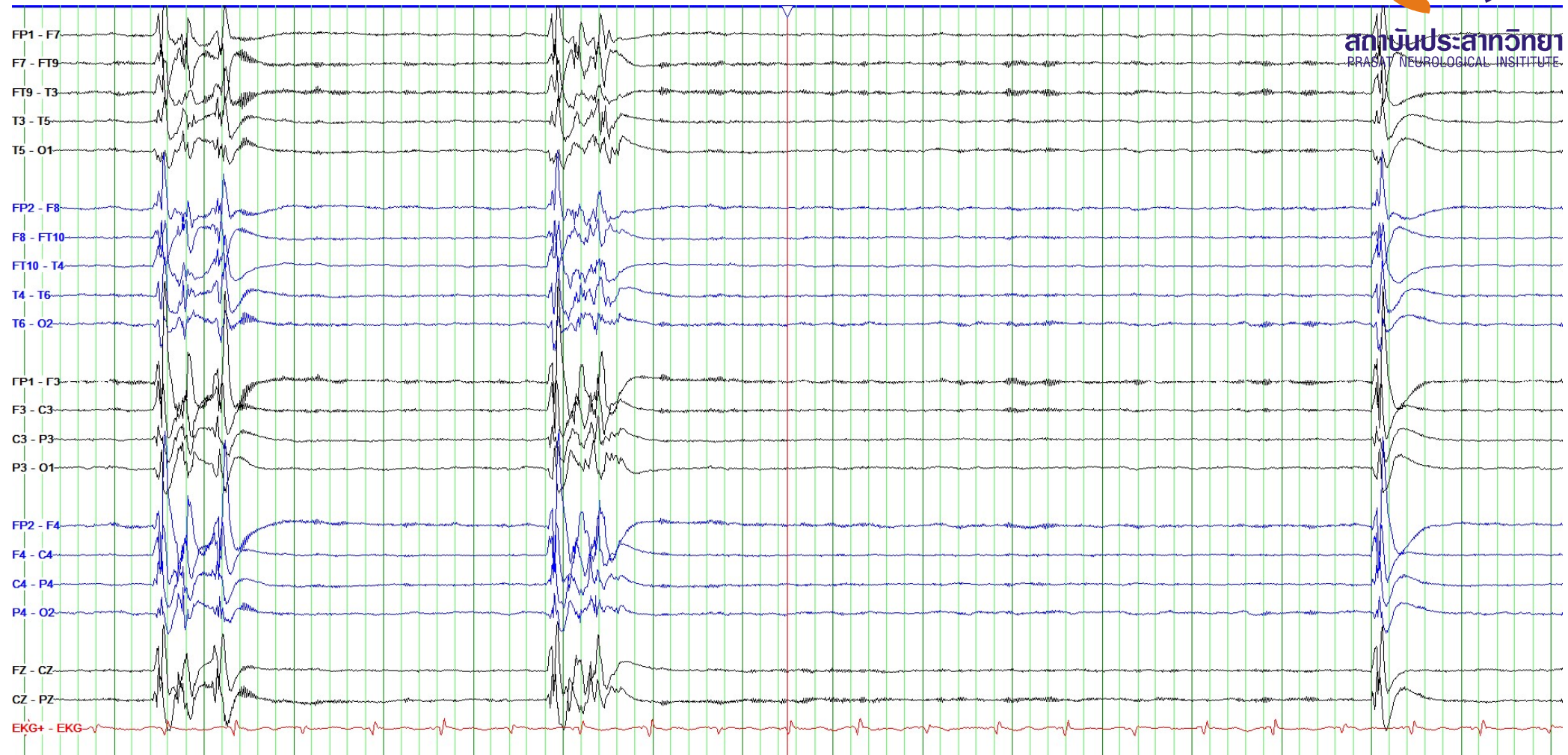
Patient with fever and unresponsive

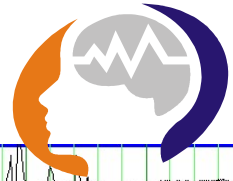


Patient with fever and unresponsive



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

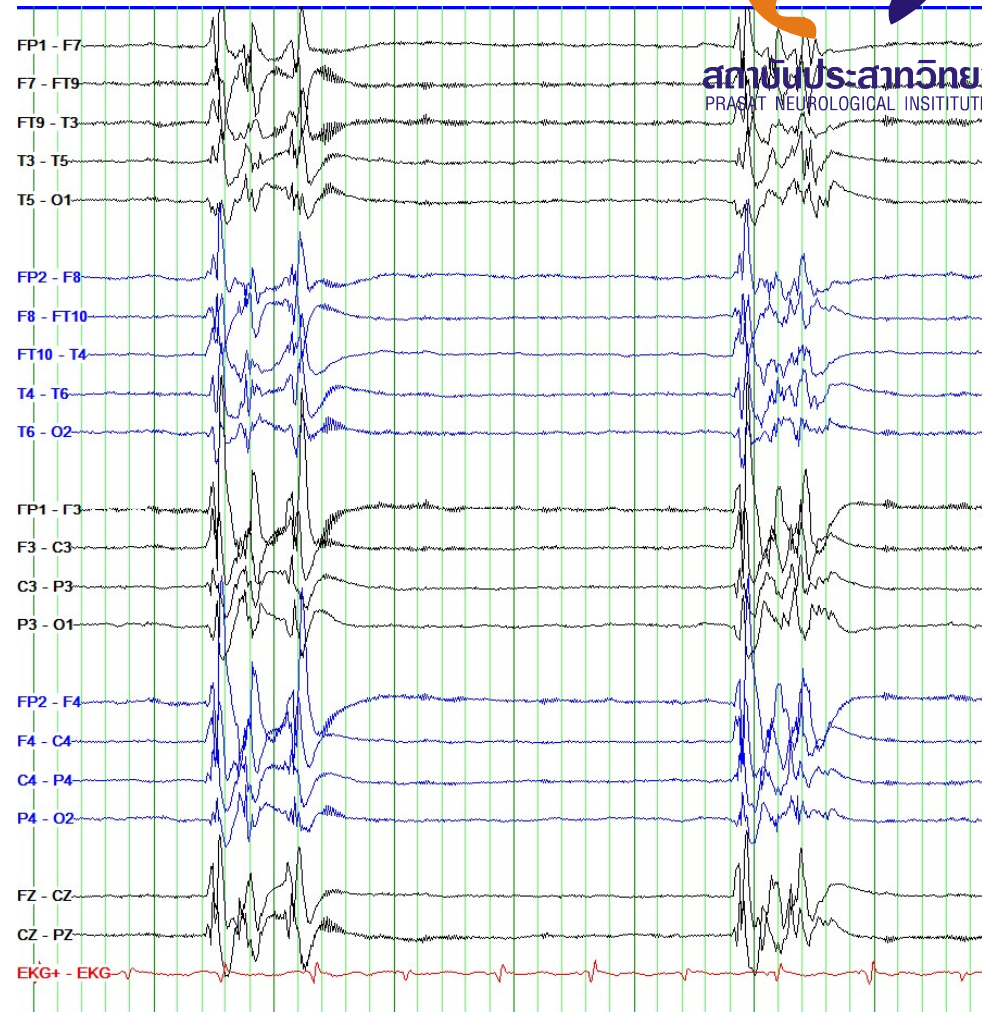
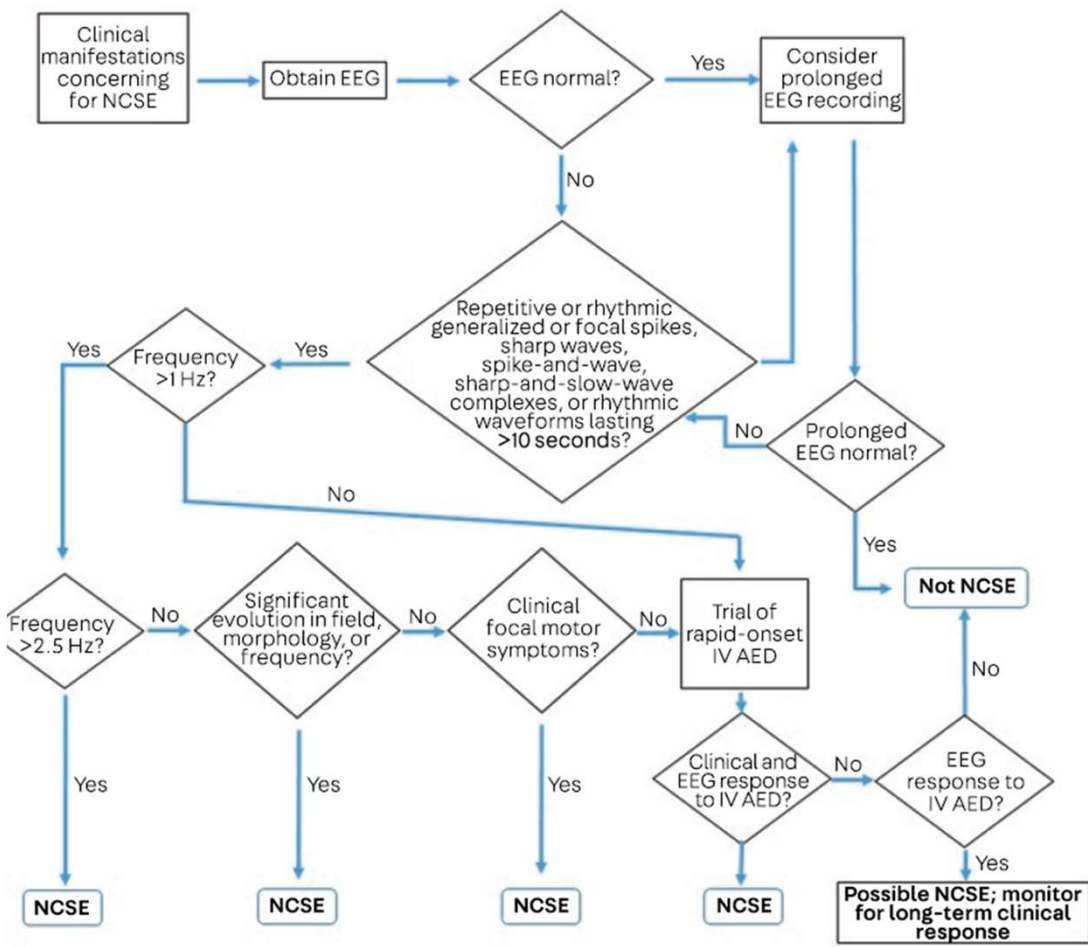




สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Review Example

Patient with fever and unresponsive



Main Term: Definitions

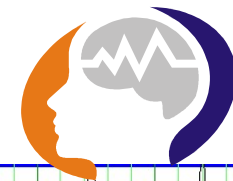


สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

• **Periodic discharges** = repeating waveforms/discharges with (relatively) uniform morphology at nearly regular intervals. Applies *only* to **single discharges** (must have ≤ 3 phases [i.e. ≤ 2 baseline crossings] or any discharge lasting ≤ 0.5 sec regardless of number of phases) and *not* to **bursts** (discharges lasting > 0.5 sec and having ≥ 4 phases [i.e. ≥ 3 baseline crossings]). “Nearly regular intervals” = cycle length (period) varying by $< 50\%$ from one cycle to the next in most ($> 50\%$) cycle pairs.

• **Rhythmic** = repetition of a waveform with relatively uniform morphology and duration and without an interval between consecutive waveforms. Duration of one cycle (the period) should vary by $< 50\%$ from the duration of the subsequent cycle for the majority ($> 50\%$) of cycle pairs to qualify as a rhythmic pattern.

Patient with fever and unresponsive



สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

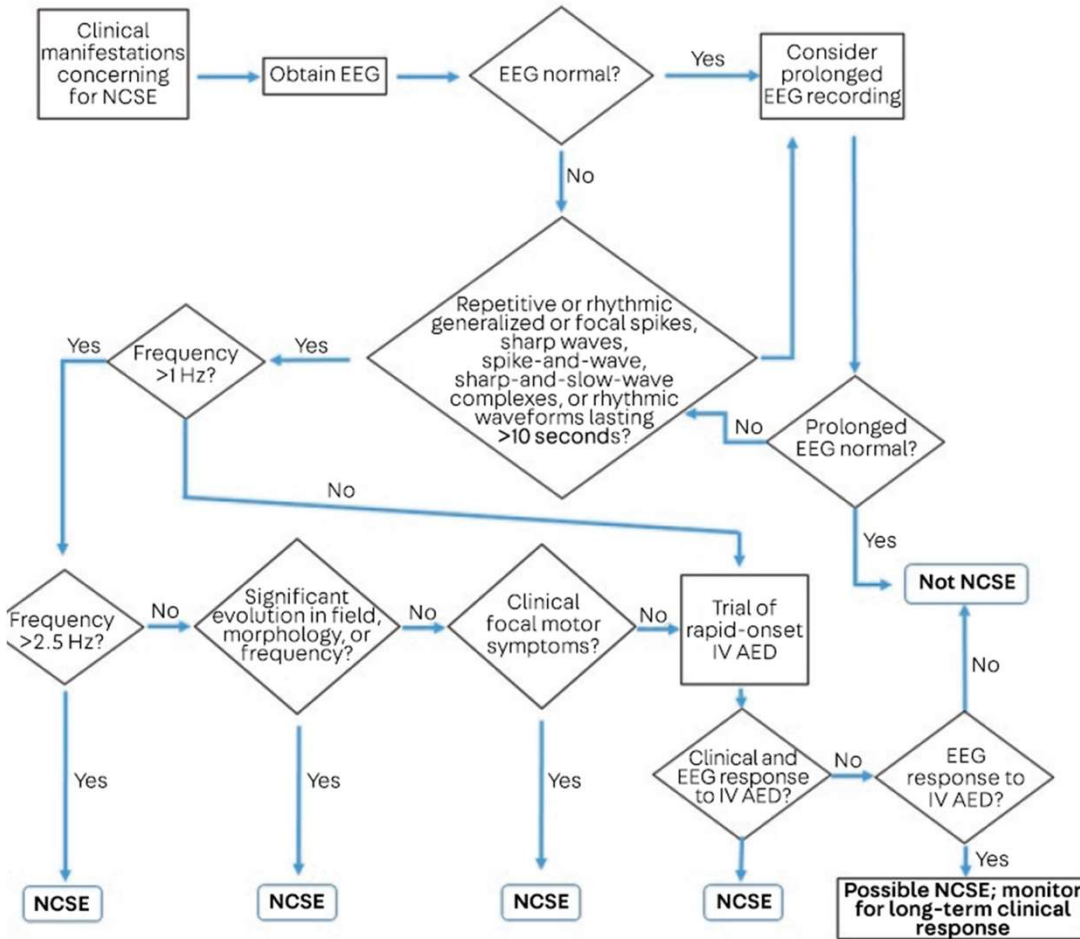




สถาบันประสาทวิทยา
PRASAT NEUROLOGICAL INSTITUTE

Review Example

Patient with fever and unresponsive





ICTAL PATTERNS

observed EEG changes during seizures. The ictal discharges during seizures do not always consist of repetitive spikes or sharp waves; instead, ictal discharges vary in morphology (eg, sharply contoured or not), frequency, and distribution. Frequently, ictal discharges show evolution patterns with changes in frequency, amplitude, field, or morphology during the course of the seizure

