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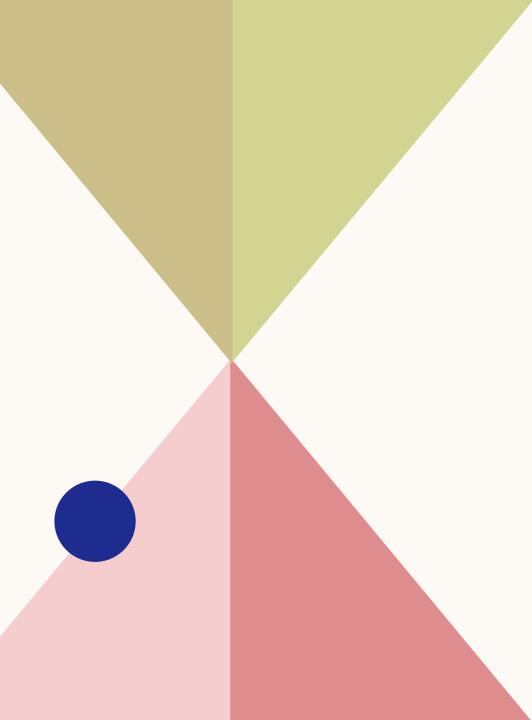


HOW TO WRITE AN EEG REPORT

Assist. Prof. Chusak Limotai Chulalongkorn Comprehensive **Epilepsy Center of Excellence** Division of Neurology, Faculty of Medicine, Chulalongkorn University "EEG reporting is like trying to translate a picture into words"

TALK OVERVIEW

- 2016 ACNS (American Clinical Neurophysiology Society) guideline
- Principal 5 Reporting Parts
- Do" and "Don't" in EEG Reports
- Standardized Computer-based EEG Report (SCORE)



WHY WE SHOULD KNOW GUIDELINE?

Guideline is not only to convey clinically relevant information, but also to improve interrater reliability for clinical and research use by standardizing the format of EEG reports.

2016 ACNS GUIDELINE IN REPORTING AN EEG (ADULT ROUTINE SCALP EEG) **KEEP IN MIND !!!**

Proper interpretation of the results reported depends on minimum technical standards for the performance of an EEG

"Minimum Technical Requirements for Performing Clinical EEG"

https://www.acns.org/practice/guidelines

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PRINCIPAL 5 REPORTING PARTS

FIVE PARTS



FIVE PARTS



Part I

HISTORY

PATIENT'S IDENTIFICATION

First/ Last name; HN/ AN; Age; Gender; DOB

THE PURPOSE OF THE EEG

e.g.,

- 1. To evaluate patients with spells of altered consciousness
- 2. To document and classify epileptiform discharges in patients with recurrent seizures and epilepsy
- 3. To evaluate patients for nonconvulsive seizures and for status epilepticus

RELEVANT CLINICAL INFORMATION

- 1. Relevant medical history
- 2. Neuroactive medications including sedatives and antiseizure drugs
- 3. Neuroimaging results
- 4. Note of any cranial operations
- 5. Whether previous EEGs have been performed

FIVE PARTS



Tatum WO et al.; J Clin Neurophysiol 2016 12

TECHNICAL DESCRIPTION

TECHNICAL PARAMETERS

DATE & LOCATION OF ACQUISITION AND INTERPRETATION

Part II

"This is a 21-channel digital EEG recording with time-locked video and single-channel electrocardiogram. Electrodes are placed according to the 10-20 (or 10-10) International System. Portions of this record are reviewed using bandpass filters of 1 to 70 Hz and sensitivity of 7 mV/mm."

- 1. Additional electrodes
- 2. Modification of 10-20/10-10 system ("prime" electrode)

THE CONDITIONS OF RECORDING

- 1. Premedication
- 2. Others;
 - ✓ Sleep deprivation
 - Potential dietary influence (fasting or NPO status)
 - ✓ Modality used (routine; continuous EEG)
- 3. The patient's state of consciousness

FIVE PARTS



Part III

Tatum WO et al.; J Clin Neurophysiol 2016 14

EEG DESCRIPTION

BACKGROUND ACTIVITY

1. Posterior dominant

rhythm, additional features of the background, and special features

Reactivity of the background

Nondominant background activity (beta, theta and delta acitivity)

4. Sleep features

HV and IPS and their effects (When omitted, the reason for their omission should be stated; documentation of poor effort)

> ✓ Augmentation of slowing or any epileptiform abnormalities

Any special characteristics present in the background

- Voltage attenuation/ Augmentation
- ✓ Suppression-burst
- ✓ Electrocerebral inactivity

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EXAMPLE 1: EEG BACKGROUND DESCRIPTIONS (AWAKE)

 The EEG background activity consisted of well-developed and well-sustained, medium-amplitude, 11-Hz posterior dominant rhythm which was symmetric and reactive to eye opening and closing during wakefulness

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EXAMPLE 2: EEG BACKGROUND DESCRIPTIONS (SLEEP)

• Symmetric sleep features including vertex waves, sleep spindles and K-complexes were seen.

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EXAMPLE 3: INTERMITTENT PHOTIC STIMULATION (IPD)

• Intermittent photic stimulation elicited symmetric photic driving response, but did not provoke abnormalities.

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EXAMPLE 4: HYPERVENTILATION

• Hyperventilation elicited diffuse slowing (which is a normal physiological response), but did not provoke abnormalities.

Part III

Tatum WO et al.; J Clin Neurophysiol 2016 24

EEG DESCRIPTION

ABNORMALITIES

Non-epileptiform abnormalities

✓ Slow waves: note

morphology; rhythmicity; voltage; continuous vs intermittent; laterality; region of involvement

Epileptiform abnormalities

- Interictal epileptiform discharges (IEDs): note
 morphology; locations; pattern; amount
- ✓ Ictal discharges: note EEG onset; propagation and postictal period; associated clinical change

Artifacts: should be reported when

- ✓ Mimic cerebral activity
- ✓ Unusual or excessive
- ✓ Interfere with interpretation
- ✓ Provide valuable diagnostic information e.g., nystagmus

Electrocardiogram findings

Morphology of slow waves

• Polymorphic (arrhythmic, irregular)

FIG. 4.—Case 3. (1) Showing 16/sec. Alpha-rhythm and 5-7/sec. frontal Theta rhythm. (2) The same position 4 months later showing increased amplitude of 5/sec. rhythm, and also frontal Delta activity. (3) Same date as (2): phase reversal of Delta rhythm over Right frontal pole.

Irregular, inconstant, slightly different wave duration

Rhythmic (monomorphic, monorhythmic)

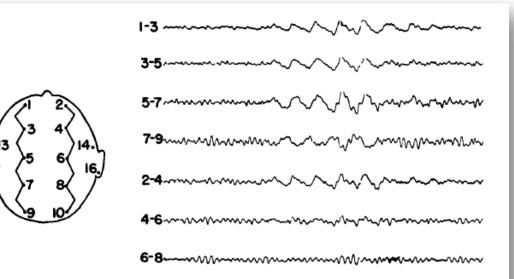


Fig. 1

Paroxysmal 2 c/sec. dysrhythmia maximal on the left side. Fifty-four-year-old man with progressive mental deterioration, nausea and vomiting. No papilledema. Ventriculography showed symmetrical hydrocephalus of lateral and third ventricles. Cyst of left cerebellar hemisphere.

Sinusoidal, stereotyped, identical wave form

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EXAMPLE 5: NON-EPILEPTIFORM ABNORMALITIES (INTERMITTENT SLOW WAVES)

 Frequent 2-3 second intermittent bursts of generalized, bifrontally predominant, high-amplitude, quasirhythmic/polymorphic 1.5-2 delta activity

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EXAMPLE 6: NON-EPILEPTIFORM ABNORMALITIES (INTERMITTENT SLOW WAVES)

 Occasional 2-3 second intermittent bursts of generalized, bifrontally predominant, high-amplitude, <u>rhythmic</u> 1.5-2 delta activity

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EXAMPLE 7: NON-EPILEPTIFORM ABNORMALITIES (CONTINUOUS SLOW WAVES)

 Continuous generalized, medium-amplitude, monomorphic
 6-7 Hz theta activity intermixed with medium- to highamplitude polymorphic 2-3 delta activity

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EXAMPLE 8: NON-EPILEPTIFORM ABNORMALITIES (CONTINUOUS SLOW WAVES)

 Continuous medium-amplitude, <u>rhythmic</u> 2.5-3 Hz delta activity (LRDA) over left cerebral hemisphere, maximum over left temporal region

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EXAMPLE 9: EPILEPTIFORM ABNORMALITIES (FOCAL IEDS)

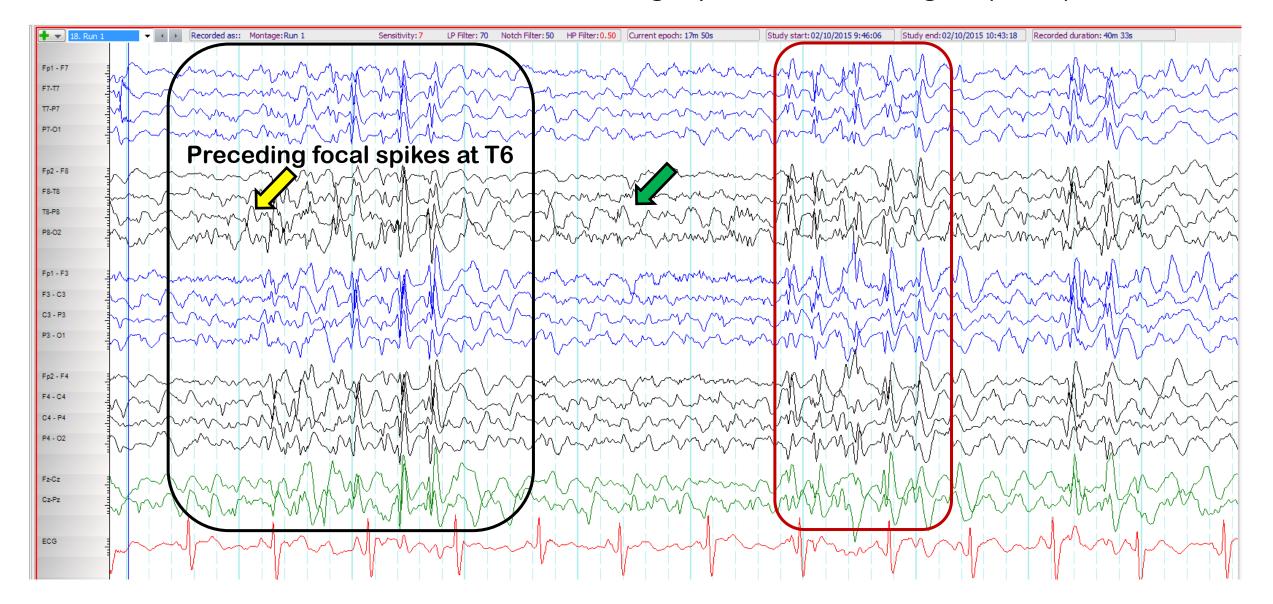
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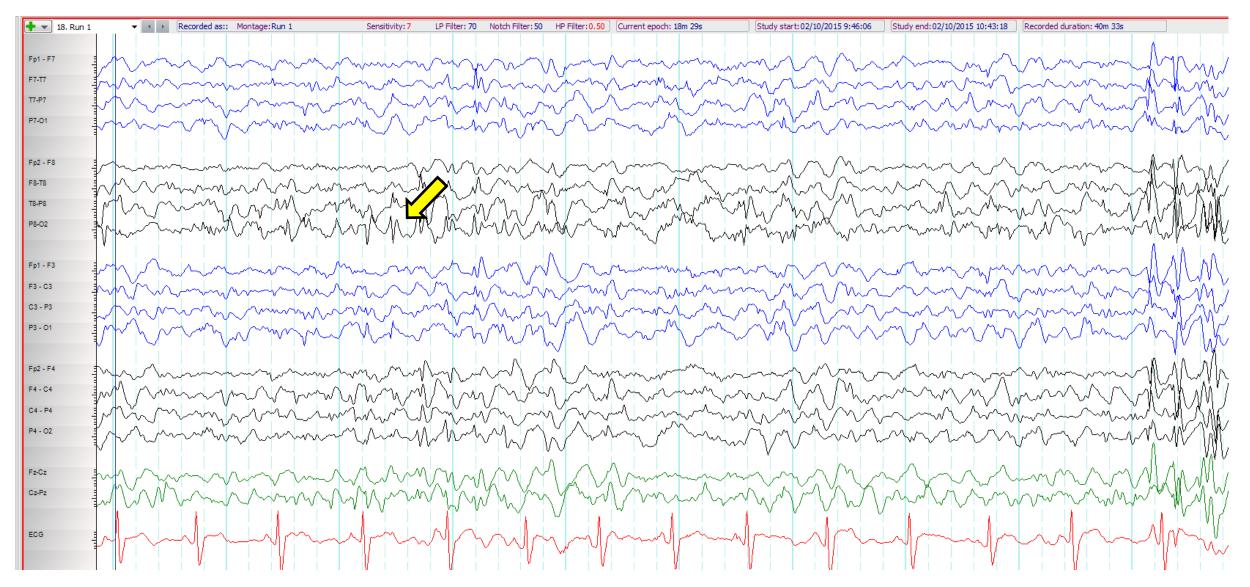
EXAMPLE 10: EPILEPTIFORM ABNORMALITIES (GENERALIZED IEDS)

 Occasional 2-3 second bursts of irregular and asymmetric, generalized, bilaterally synchronous, left hemispheric predominant, 3.5-4 Hz spike-and-wave epileptiform discharges

Prominent focal slow waves at right posterior head region (T6O2)



Focal spike-and-slow wave epileptiform discharge at right occipital region (O2)



EXAMPLE 11: EPILEPTIFORM ABNORMALITIES (GENERALIZED IEDS)

 Abundant 2-3 second bursts of irregular and asymmetric, generalized, bilaterally synchronous, posterior head region predominant, 2.5 Hz polyspike-and-wave epileptiform discharges with preceding focal spikes identified over right posterior head region maximally at T6, representing secondary bilateral synchrony pattern







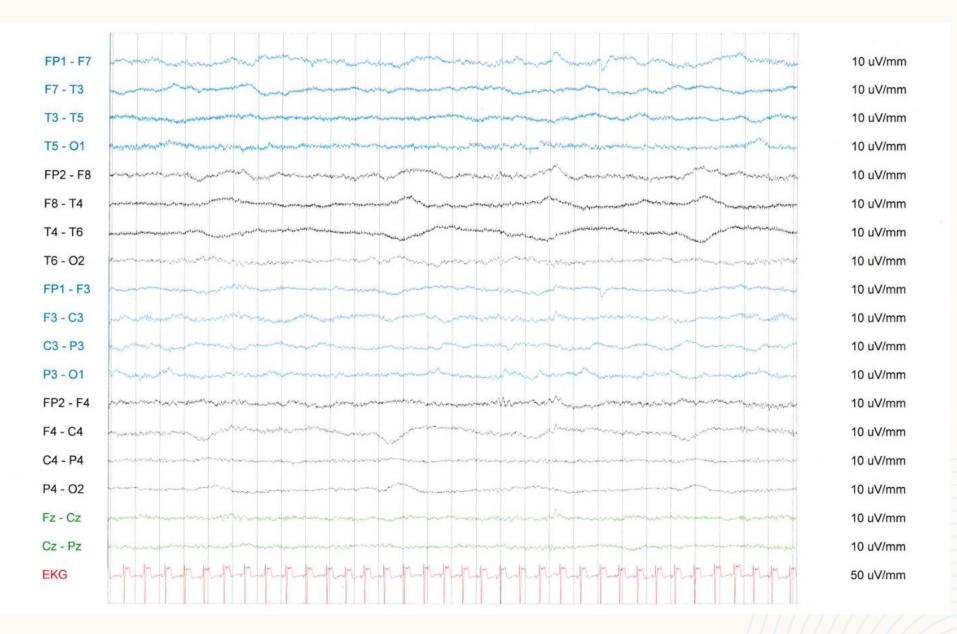
EXAMPLE 12: EPILEPTIFORM ABNORMALITIES (ICTAL/SEIZURE)

 One electroclinical seizure characterized by clinical right facial clonic activity associated with ictal EEG change of increased rhythmic alpha and fast activity over left cerebral hemisphere maximally over left centro-parietral region (C3P3) with subsequent evolving over the same area. This lasted for 30 seconds. Example 1: Artifacts that should be reported

> Mimic cerebral activity

Mimic diffuse slowing

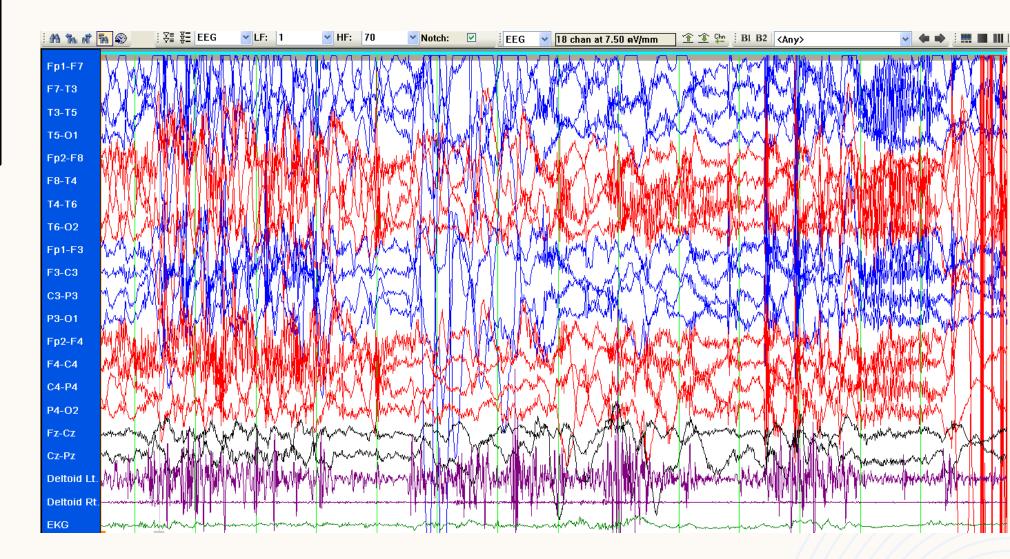
"Sweat artifacts"



Example 2: Artifacts that should be reported

Interfere interpretation

"Technical difficulty"



FIVE PARTS



Part IV

Tatum WO et al.; J Clin Neurophysiol 2016 48

IMPRESSION

NORMAL/ ABNORMAL

- - IEDs
 - Slow waves
 - Abnormalities of the background activities

- The summary of the findings should be stated succinctly in layman's terms
- Preferably no more than 3 or 4 abnormalities

FIVE PARTS



CLINICAL CORRELATION

Part V

INTEGRATE EEG FINDINGS WITH THE CLINICAL INFORMATION

- The clinical correlation should clearly express the relevance of the findings to the clinician
- Avoiding technical terminology is helpful to convey the message to the least experienced clinician on the team caring for the patient
 - should be understandable to a general practitioner or nurse

CLINICAL CORRELATION

Part V

EXAMPLE I

- "A normal interictal EEG does not exclude nor support the diagnosis of epilepsy."
- "Focal slowing suggests an underlying lesion involving the white matter of the ipsilateral hemisphere."
- "Diffuse slowing of the background activity reflects a (include degree: mild, moderate, and severe) diffuse cortical dysfunction, which can be seen with toxicmetabolic or systemic causes, or neurodegenerative disorders, and also with cortical injury."

CLINICAL CORRELATION

Part V

EXAMPLE II

"The generalized spike-and-waves seen in this tracing imply a generalized mechanism in a patient with a clinical diagnosis of epilepsy but may also represent an inherited trait independent of clinical seizures

"The left anterior temporal spikes suggest focal hypersynchrony in a patient with a clinical diagnosis of epilepsy and carry a heightened risk for focal-onset seizures of temporal lobe origin.

CLINICAL CORRELATION

Part V

EXAMPLE III

""The suppression-burst pattern following normothermic cardiac arrest (in the absence of anesthetic drugs) suggests a poor prognosis for neurologic outcome."

Examples of words/ phrases

Cerebral dysfunction: More than mild
 Mild: minor irregularities in cerebral function

IEDs: suggest potential epileptogenesis

• EEG abnormality fit with the clinical information: is consistent with, is supportive the diagnosis

 Clinical manifestation present at the time of the recording: is diagnostic of

CLINICAL CORRELATION

SUGGESTIONS FOR FURTHER INVESTIGATIONS

- May suggest
 - ✓ A repeat EEG with sleep-deprivation, ambulatory EEG, video-EEG monitoring,
 - ✓ Referral to a sleep laboratory when sleep apnea is suspected
 - ✓ Further cardiologic evaluation when the electrocardiogram is abnormal

When previous EEGs are available, comparison of the current record to previous tracings should be included

Part V

"DO" AND "DON'T" IN EEG REPORTS

"DO" IN EEG REPORT

Kaplan PW & Benbadis SR; Neurology 2012

Table 1 Items to include in an EEG report Introduction Medical conditions and clinical question •Whether sleep-deprived Medications elf sedation was used Fasting or not Level of consciousness at the beginning, and changes during the recording •Eyes open or closed at the beginning of the recording. Further changes in eye closure, deviation, nystagmus are noted in the description of the record, below Number of scalp electrodes; International 10-20 System •Extra recording electrodes and their purpose, e.g., ECG, EMG, respiration Duration; time started and ended Description of record Dominant background activity (alpha rhythm or posterior dominant rhythm): response to eye opening; to limb movement •Comment on all frequencies (beta, theta, delta); note whether they are symmetric, and sustained or not. Note and comment on the sleep patterns Note symmetry, distribution, persistence, and amplitude of activity in microvolts •Comment whether this activity is continuous or intermittent. Qualitative modifiers alone, such as "medium voltage," provide a less-precise documentation •Mention how particular stimulating or arousal procedures affect the record, change frequencies or amplitude, or produce epileptiform activity

•Note any seizures and their morphologic, frequency, localization, and temporal characteristics

Interpretation

•Normal or abnormal EEG, and, e.g., "this EEG shows an encephalopathy" or "this EEG shows status epilepticus"

•Use wording that can be understood by the referring person, e.g., general physician, nurse practitioner

•Note whether the findings support, or do not support, the clinical question

•If abnormal, provide reasons why this is so

• Compare with other EEGs available; suggest if further EEGs may help, e.g., with sleep if the referral event occurred during sleep; or with activation if this specific activity triggered the event in question

Clinical correlation

. If possible tie in EEG with the clinical question

FREQUENTLY SEEN THINGS TO AVOID

Table 2 Some don't's: Frequently seen things to avoid^a

•Mixing advice or recommendation in a report. An EEG report only reports on the EEG and should not make management recommendations.

•Merging a SOAP (Subjective, Objective, Assessment, Plan in clinical formatting) note with an EEG report. The EEG is only part of the clinical picture.

• Using the phrase "phase reversal" as if it implied epileptic phenomenon or even abnormality. Phase reversals in themselves only indicate location (S.R. Benbadis in this supplement).

•Reciting a "laundry list" of possible differential diagnoses that obscure rather than clarify.

•Inconclusive reporting that does not commit to the findings. The report should be succinct and clear.

•Stating that "clinical correlation is warranted" or recommended is obvious and unnecessary.

• Avoid being vague when it is possible to be more specific. Go beyond general terms such as "seizure disorder" if possible, and classify the seizure type or epilepsy. If the history describes staring, myoclonus, and tonic-clonic seizures, and the EEG shows runs of generalized 3- to 4-Hz polyspike wave, then this "strongly suggests a genetic generalized epilepsy." Seizures that include staring, and have clear temporal sharp waves on EEG provide strong support for a clinical diagnosis of focal (temporal lobe) epilepsy.

•Using noncommittal phrases such as "consistent with" or "compatible with" a particular condition is not helpful, because many EEGs are consistent (normal or not) with many conditions (and a normal EEG is certainly "consistent with" epilepsy). If, however, the EEG is strongly suggestive of a condition, then the wording could be "... these findings are found in association with ..., but not necessarily indicative of..."

Kaplan PW & Benbadis SR; Neurology 2012

WHAT TO AVOID IN EEG REPORT

- ✓ Avoid criticism of the referring physician
- ✓ Refrain from suggesting treatment
- ✓ Avoid, if possible, classification systems that are not widely used
- ✓ Do not mix therapeutic advice in the report
- ✓ If EEG strongly supports a particular diagnosis, say so
- ✓ Avoid a laundry list of possible differential diagnoses in the clinical correlation

STANDARDIZED COMPUTER-BASED EEG REPORT (SCORE)

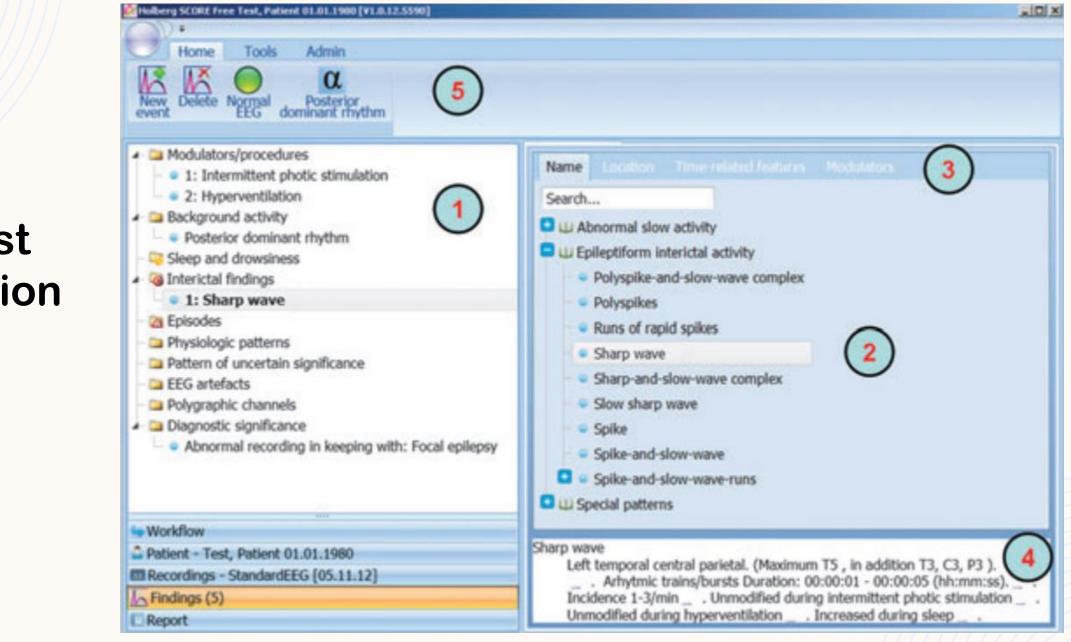
SPECIAL REPORT

Standardized Computer-based Organized Reporting of EEG: SCORE

*†Sándor Beniczky, ‡Harald Aurlien, ‡Jan C. Brøgger, †Anders Fuglsang-Frederiksen, §António Martins-da-Silva, ¶Eugen Trinka, #Gerhard Visser, ***Guido Rubboli, *Helle Hjalgrim, ††Hermann Stefan, ‡‡Ingmar Rosén, §§Jana Zarubova, ¶Judith Dobesberger, *Jørgen Alving, ¶##Kjeld V. Andersen, ¶¶Martin Fabricius, *Mary D. Atkins, ***Miri Neufeld, †††Perrine Plouin, ‡‡‡Petr Marusic, §§§Ronit Pressler, ¶¶¶Ruta Mameniskiene, ††Rüdiger Hopfengärtner, #Walter van Emde Boas, and ###Peter Wolf

- Computer-based system for EEG assessment and reporting, where the physicians would construct the reports by choosing from predefined elements for
 - ✓ Each relevant EEG feature
 - ✓ The clinical phenomena (for video-EEG recordings)

It will make possible the build-up of a multinational database, and it will help in training young neurophysiologists



First Version

Beniczky S et al.; Epilepsia 2013

Second Version

Home Tools Admin Constant of the tools and tools and the tools and tools and tools and the tools and tools	
▲ 📮 Modulators/procedures (2)	Finding details
 —	Finding summary *
 Quantitation 	Posterior dominant rhythm
⊿- □ Background activity (1)	Properties: Normal activity 9.0 - 10.0 Hz Medium amplitude (20-70µV) Symmetrical amplitude
Posterior dominant rhythm	. Reactive to eye opening Normal organization Symmetrical frequency
- 📮 Sleep and drowsiness	Name Properties
🕢 🐻 Interictal findings (1)	
Epileptiform interictal activity (1)	Significance
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Generalized seizure - Absence - Typical	No definite abnormality
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Abnormal recording supporting: Generalized idiopatic epilepsy	Asymmetry not possible to determine Reduced reactivity both sides Markedly disorganized
	O Not possible to determine
	Frequency asymmetry Caveat Absence of posterior dominant rhythm (PDR)
1177	Not scored O Not scored O Not scored
Set Workflow	Symmetrical Free text ONo Only open eyes during the recording Extreme low voltage
Patient - Test, Patient 11/10/2009	#Hz lower left Sleep-deprived Extreme low voltage
Recordings - StandardEEG [11/10/2016]	#Hz lower right Drowsy Lack of awake period
Findings (9)	Lack of compliance
E Report (14/10/2016)	Other causes (+ free text)
P Search	

Beniczky S et al.; Clin Neurophysiol 2017

THANK YOU FOR YOUR ATTENTION

