Northwestern Memorial® Hospital

CLINICAL GUIDELINE

Subject: **NEUROLOGICAL TESTING CENTER**	Page 9	NTC Policy #1
Title: **ADULT ROUTINE EEG PROTOCOL**	Revision of: NEW	Effective Date:

I. PURPOSE:

To provide guidelines for the recording of adult electroencephalogram (EEG) in accordance with the American Clinical Neurophysiology Society (ACNS).

II. CLINICAL GUIDELINE:

Outpatient EEG: Main purpose of the EEG is to capture interictal epileptiform activity. Patients are instructed to continue their anticonvulsant and prescription medications unless notified otherwise by their physician. Patients will undergo photic stimulation (PS) and hyperventilation (HV) unless specific contraindications are present. **Sleep deprivation**: Patients are instructed to sleep no more than 4-5 hours the night preceding testing and not to take any stimulants or sedatives the morning of the testing;

Inpatient (aka portable) EEG: Main purpose of the EEG is to assess for interictal and ictal epileptiform activity explaining the patient's acute symptoms. Unless the patient is awake and alert and there are no contraindications, HV and PS are usually not performed.

Testing and documentation of responsiveness to verbal, tactile and (if indicated) painful stimulation and level of consciousness is pertinent for the EEG interpretation. In case the patient has a clinical event during the EEG recording, standard seizure testing should be performed and documented.

III. PERSONS AFFECTED:

Neurological Testing Center technical staff and Attending Neurophysiologist

IV. PROCEDURE GUIDELINES:

A. SAFETY:

1. Equipment:
    a. All equipment to be used on patients must first be inspected by BioMed and have proper asset tags.
        i. Leakage current from chassis to ground should not exceed 100 µA, 50 µA from EEG amplifier if input is non-insulated, and not more than 20 µA for isolated inputs. It is recommended that only electrodes with isolated inputs be used.
    b. Adequate grounding of equipment must be provided by all AC receptacles and be grounded to a common point. There should only be one ground electrode on patient.

c. Plug of power cord must always be fully inserted into outlet so as to not leave any area exposed.
d. If using EEG equipment in operating room, consider hazards of explosive anesthetic agent and consult with anesthesiologist as to whether this is being used. If so, use long electrode cable; never use an extension power cord in such instances.

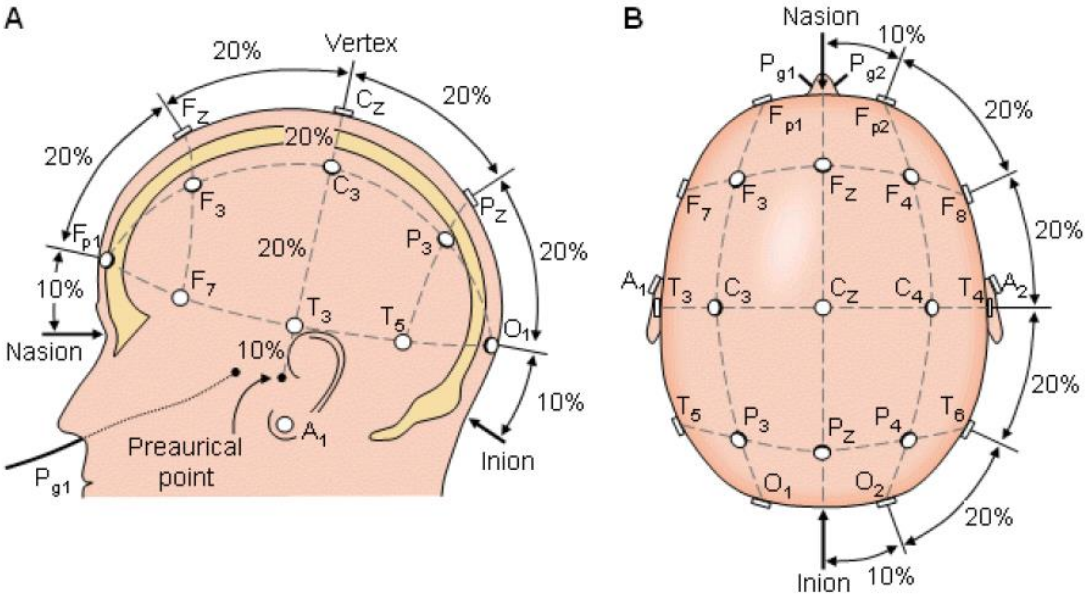
2. Supervision
   a. Patients have to be observed throughout the duration of the study.

B. DIGITAL SPECIFICATIONS:

1. The following provides recommended specifications for digital recording. Systems should be verified for the following and any deviations from recommendations should be clearly documented.
   a. Sampling rate minimum of 200Hz
   b. Sensitivity = 7 µV/mm
   c. Filter settings should be set to 1.6 Hz for Low Frequency Filter (LFF) and 70 Hz for High Frequency Filter (HFF)
   d. Digital speed setting should be 30 mm/sec
   e. Calibration input signal should be 50 µV. Appropriate calibrations must be made at the beginning and end of every EEG recording for 20-30 seconds.
   f. Notch filter should be turned off during study acquisition unless there is a compelling and documented reason.

C. TECHNICAL SPECIFICATIONS:

1. Electrode Placement
   a. Electroencephalogram (EEG)
      i. Measure and mark head with grease pencil in accordance to the 10-20 System recommended by the *International Federation of Clinical Neurophysiology (IFCN; Jasper HH, 1958, 1983)*



Note: We will use the new nomenclature: **T7** = T3, **P7** = T5; **T8** = T4, **P8** = T6.

ii. Prep skin by cleaning with a cotton swab at sites for electrode placement.
iii. Secure electrodes to the scalp with paste and cotton ball or gauze dipped in collodion.
    1. Patients who are scheduled for EEG plus subsequent video EEG monitoring should be hooked up with collodion for the initial EEG.
    2. Patients who are scheduled for video EEG monitoring and additional brain imaging studies after the routine EEG should be hooked up with collodion and imaging compatible electrodes.
iv. Draw diagram of skull abnormalities and describe in report.
v. Document deviations to the 10–20 System if electrode placement is estimated due to skull abnormalities

b. Electrocardiogram (EKG)
    i. A single modified lead 2 EKG electrode placement is recommended.
    ii. Rub site briskly with alcohol pad and dry with a 2x2 gauze.
    iii. Be sure that the electrode has adequate gel and is not dry
    iv. Attach right EKG pad slightly inferior of the center of the right clavicle.
    v. Attach left EKG pad inferior and left of the left nipple.

2. Impedances
    a. Impedances should be less than 5K Ω.
    b. Electrode impedances should be rechecked during a recording when any pattern that might be artifactual appears.
    c. Re-gel or replace popping electrodes
    d. Note any medical conditions/ treatments which may affect impedances.

D. DATA ACQUISITION:
1. Montages (see Appendices)—The following provides some general guidelines for selection of montage
        i. RUN I—Bipolar montage.
            1. Record majority of record in RUN 1.
        ii. RUN II—Referential montage.
            1. Run 1-2 minutes of RUN II.
        iii. RUN V—Bipolar montage.
            1. Run 1-2 minutes of RUN V, particularly during sleep
2. Sleep and Stimulation
        i. Encourage sleep during the first 20 minutes of the recording. If patient is not asleep by the end of electrode placement, test response to eye opening and closing. Consider early HV to facilitate sleep.
        ii. At minimum, collect 120 (10s) epochs (20 minutes) excluding periods of activation and <u>after</u> you corrected all electrode issues and ran another impedance check.
            2. Begin with RUN I
            3. Record 2 epochs of eyes closed; gently assist with holding patient's eyes closed if necessary.
            4. Record 2 epochs with eyes open. Eyes should be kept open for at least 10 seconds without blinking.
            5. Perform photic stimulation (PS). Frequency 1-21Hz.
            6. Use RUN II and RUN V and other montages as needed.
3. Hyperventilation
        i. Arouse patient and explain hyperventilation (HV). Patient performs HV for minimum of 3 minutes.
        ii. Record for 2 minutes post HV before starting PS or other activation
        iii. Contraindications: severe pulmonary disease or asthma, heart or brain surgery within the last 60 days, acute subarachnoid hemorrhage or acute stroke, sickle-cell anemia, or patient inability or unwillingness to cooperate.

iv. Patients admitted for acute brain insults or change in mental status should usually not be hyperventilated unless specifically requested by the physician.

4. Patient Activation
    i. Perform mental activation and assess the patient's orientation to person, place, and time. Patient should be fully alert for at least 2 minutes (12 pages)
    ii. Perform another eye opening and closure
5. Study Conclusion
    i. If you abnormalities in the recording which may warrant a more prolonged recording, notify EEG physician on call before ending the study.
    ii. Complete EEG record by running calibration for all settings used.
    iii. Stop the recording and disconnect patient from amplifier.
        1. Remove electrodes (with acetone if collodion was used) and clean patient's head.
        2. Outpatient: Always escort the patient to discharge desk or call for patient transport.
        3. Inpatient: Notify the nurse that you completed the EEG.
    iv. Transfer study to server and confirm that the study is linked to the database and database schedule.
    v. If the patient had a clinical event, annotate study so that the video is kept for archiving.
    vi. Clean room and electrodes per manufacturer guidelines.

E. DOCUMENTATION:
1. Identification—2 patient identifiers must always be used. Ask patient to tell you his/her name and date of birth (DOB). If inpatient, also verify wristband of patient.
2. Clinical Information— Patient history, if available, should always be reviewed. Clinical information should be documented and include the following:
    i. Seizure description based on patient recollection. Verify if possible by witness description.
    ii. Risk factors for seizures.
    iii. Head trauma and recent brain/head surgery, febrile convulsions, brain infection.
    iv. Family history of seizures.
    v. Trigger factors.
    vi. Current antiepileptic and other pertinent medications
    vii. Pertinent past medical history
    viii. Imaging: if available, provide impression of last brain imaging.

ix. Outpatient: verify amount of sleep deprivation.
x. If you encounter an unusual large build-up during HV, please ask when patient had last meal and document.

3. Record Annotation
    i. Demographics and log number:
        1. Patient's name and MRN.
        2. Patient's age and DOB.
        3. Date of service.
        4. Assignment of study number in Logbook application.
    ii. EEG annotation:
        1. Background.
        2. When possible, identify sleep stages (if present).
        3. Interictal non-epileptiform and epileptiform abnormalities.
        4. Clinical and EEG seizure onset and end.
        5. Documentation of activation (HV, PS, activation).

4. Artifact
    i. Artifact should be identified and corrected when possible.
    ii. Any physiological or environmental artifact affecting the recording should be documented, including but not limited to the following:
        1. Eye movements
        2. Respiration artifact
        3. Muscle artifact
        4. Sweat artifact
        5. Gross movement (yawn, sneeze, jerk, laugh, etc.)
        6. EKG
        7. 60Hz
        8. Electrical devices (i.e. pacemaker)
5. Patient Response
    i. Patient's level of consciousness (awake, drowsy, sleeping or comatose).
    ii. Response to auditory, tactile and if indicated painful stimulation should be documented.
6. Report
    i. Report should be completed by technician within 30 minutes of completion of study. If there is scheduled, recurring downtime of the electronic system, open the report as soon as the system is available. If there is a non-scheduled downtime of the reporting system, notify the help desk and then the physician.
    ii. Report should contain the following:
        1. Name of activity, frequency, amplitude, location, morphology, rhythmicity, amount, reactivity

(e.g. Posterior background: 8-10 Hz, 40-70 uV, posterior head regions, symmetric, waxing and waning, reactive to eye opening and closure).

2. Describe any unusual behavior during recording and testing if applicable

7. Billing
    i. Technical charges for inpatient and outpatient EEG's are to be entered by performing staff on the same day of procedure through Cerner Entry batch program.

F. COMMUNICATION:

1. For studies which will not be completed (report open and file on server) before 4 pm, notify EEG physician reader for that day ahead of time. If necessary, page EEG physician, On Call to announce that there is an after hour EEG to be read.
2. For any record which shows electrographic seizure activity or captures a clinical event, notify reading physician immediately.
    i. Select *Critical EEG* for Study Type in Chartscript for records with confirmed electrographic or clinical epileptic seizure activity.
    ii. For any routine EEG which captures a relevant event, the video should be archived and the technician should label the study accordingly.
3. Notify attending neurophysiologist of any patient safety concerns which arise during the study. This includes, but is not limited to, any delays in providing patient care, particularly with emergency EEGs.
    i. For any incidents which could have resulted in patient harm/injury, complete a *NETS* report in accordance with NMH Patient Care Policy 5.08 *Risk Management Incident and Event Reporting*.
    ii. Page the EEG physician service and the NTC manager about any incident which resulted in patient harm/injury immediately.
    iii. Notify NTC Manager with any patient related concerns / issues.

G. TROUBLESHOOTING:

1. It is the responsibility of the technologist to independently resolve any equipment issues that may arise first and then to appropriately escalate to NTC Systems Coordinator.
    i. NTC Systems Coordinator will be responsible for:
        1. Any application issues (calling vendor Tech Support to resolve)
        2. Any hardware related issues (e.g. amplifier, cable).
2. For any server or network issues:
    i. The technologist is to call 6-HELP (6-4357) to request a route ticket for the issue and try to resolve.

ii. Contact NTC Systems Coordinator with ticket number.
iii. It is the responsibility of the NTC Systems Coordinator to follow up on tickets opened and ensure a "closed" status in a timely manner.

POLICY UPDATE SCHEDULE:

Minimum of every three years or more often as appropriate.

REFERENCES:

1. *Guideline1: Minimum Technical Requirements for Performing Clinical Electroencephalographpy, American Clinical Neurophysiology Society, 2006*
2. *International Federation of Clinical Neurophysiology (IFCN; Jasper HH, 1958, 1983)*
3. *Fundamentals of EEG Technology: Basic Concepts and Methods (Tyner, Fay S, 1983)*

Appendix A:
Montages: RUN I - VI; TNO; HEADBAND; NEONATE; ECS
Guidelines for ordering Emergency EEGs and cVEEG monitoring

Appendix B: Clinical Guidelines:
Electroencephalography as Supportive Testing in the Determination of Brain Death
Neonatal EEG Protocol

APPROVAL

Responsible Party:	Manager, Neurological Testing and Sleep Disorders Center
Reviewers:	Medical Director, Neurological Testing Center Manager, Neurological Testing and Sleep Disorders Program Director, Comprehensive Epilepsy Center
Approval Parties:	Manager, Neurological Testing and Sleep Disorders Center Medical Director, Neurological Testing Center

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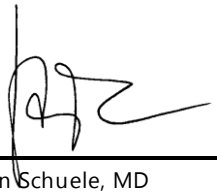
Policy Approved by:

X 

Judith Wood
Manager, Neurological Testing Center

X 

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