

TECHNICAL STANDARDS COMMITTEE 2010 - 2011

STANDARD ONE:

MINIMAL TECHNICAL STANDARDS CLINICAL ELECTROENCEPHALOGRAPHY: ROUTINE ADULT

INTRODUCTION:

The following recommendations represent the minimum standards for routine clinical recording of the adult EEG and are consistent with the “*Core Entry-to-Practice Competencies for the Profession of Electroencephalography Technology*” – January 2008.

A) EQUIPMENT

1.0 RECORDING INSTRUMENT:

- 1.1** All recording systems and ancillary equipment must meet specifications and safety requirements outlined in “*Guidelines for Digital EEG*”, as endorsed by the Organisation of Societies for Electrophysiological Technology (OSET) in 1999.
- 1.2** Digital EEG recording systems are necessary for the recording of clinical EEGs. Paper tracings are no longer acceptable.
- 1.3** Amplification and channel acquisition must be available for a minimum of 24 and preferably 32 channels for extra derivation recording.
- 1.4** Electrical safety of equipment must be ensured by:
 - initial approval of the Canadian Standards Association (CSA);
 - yearly preventive maintenance checks by certified biomedical technicians to ascertain proper grounding and safe levels of chassis leakage current (not exceeding 100 microamperes); and
 - supporting documentation of electrical safety of the recording apparatus.
- 1.5** Faulty equipment must be removed from service until it meets safety requirements.

- 1.6 An extension cord must not be used between any AC outlet and the 3-pronged plug of the EEG instrument cable. The use of an extension cord increases the leakage current by an unknown and potentially hazardous factor.
- 1.7 Alternating current (AC) wiring must meet the Underwriters' Laboratories standards for hospital grade service. All AC receptacles must provide adequate instrument grounding. The integrity of the ground pin of the recording instrument's power cable should be checked periodically.

2.0 ELECTRODES:

- 2.1 Surface, disk electrodes are recommended for routine, clinical use. Electrodes recognized for good recording properties should be employed (i.e. silver/silver chloride and gold among other compositions).
- 2.2 Subdermal electrodes are not recommended for routine, clinical recording. When exceptional clinical circumstances warrant their use, the needles must be sterile and disposed of following testing.
- 2.3 Electro-caps should not be used for routine clinical recordings.
- 2.4 All electrodes applied to a given patient must be of the same type and size to minimize potential difference occurring between electrodes.

3.0 PHOTIC STIMULATOR:

- 3.1 Laboratories should determine the type, intensity and luminance levels of their photic stimulators. Specifications should be in keeping with those outlined in the "*Guidelines for Visual-Sensitive EEG Testing*", 2008.
- 3.2 For routine recording, the stimulator should lack pattern or grid yet have the capability for their use, as required.
- 3.3 The photic stimulator should be capable of delivering single flashes and trains of flashes of constant intensity (1 joule/flash) at frequencies between 1 and 60 Hz.

4.0 ANCILLARY EQUIPMENT

- 4.1** All ancillary equipment must have initial approval of the Canadian Standards Association (CSA) and undergo subsequent, annual maintenance checks.

B) TEST PREPARATION:

1.0 DOCUMENTATION/PATIENT PREPARATION:

- 1.1** A duly authorized referral for patient testing is required. Minimally, the patient's name, date of birth, and provincial health insurance number must appear. Relevant clinical information and known contraindications are essential.
- 1.2** The technologist should review the patient referral prior to testing to become familiar with the history and to determine the need for additional information.
- 1.3** Additional, relevant information (including any limitations as they pertain to testing) should be documented on the referral. Sources for the medical history may include: the patient; the patient's chart; a family member; a caregiver; or medical staff.
- 1.4** The technologist should fully explain the procedure and respond to patient/representative questions with clear and relevant information.

2.0 ELECTRODE PLACEMENT/APPLICATION/REMOVAL:

- 2.1** The International 10-20 System of Electrode Placement is to be used to determine the location of electrode positions. The sites should be accurately mapped using a tape measure and a non-toxic pencil/marker.
- 2.2** In addition to the 21 standard electrodes, the technologist should apply extra leads for artefact monitoring and for further localization, as required.
- 2.2** A system reference electrode is required for recording.
- 2.4** The application of a ground electrode is recommended for routine recording. *The technologist must ensure that there will*

be only one ground electrode on the patient to avoid the potential risk of a ground loop.

- 2.5 Rubbing each electrode site with an abrasive skin preparation prior to lead application is recommended for lowering impedances. The product should be used sparingly and the patient's skin must not be broken.
- 2.6 The use of blunt-tipped needles to reduce impedances is discouraged.
- 2.7 Stable electrode application for routine recordings is achieved through use of a variety of conductive electrode creams or pastes.
- 2.8 The use of ether-based products such as collodion is not recommended for electrode application in the routine setting. Where its use is unavoidable, ventilation must meet established standards for safety. (*see Material Safety Data Sheet [MSDS] #C5071, effective date 0701/09, Mallinckrodt Chemicals*)
- 2.9 Measurements plus residue from gel and paste should be removed from the patient's scalp and hair following the EEG.

C) RECORDING PROCEDURE

1.0 DOCUMENTATION:

- 1.1 As a minimum, the patient's name, date of birth, identification number, and test date must be entered in the recording system's electronic database.
- 1.2 A separate technologist data sheet for each EEG recording is recommended. In addition to details outlined in 1.1 above, it should include:
 - medications;
 - relevant clinical history and observations;
 - hand dominance;
 - time of last nourishment;
 - skull anomalies (scars, asymmetries);
 - technologist impressions; and
 - the name of the recording technologist.

2.0 CALIBRATION:

2.1 Recorder calibration should be performed at the beginning of each EEG. Numeric calibration values should be saved with each recording and available for review during playback. Conventional square wave pulse and bio-calibration are optional at the beginning and end of the test.

3.0 IMPEDANCES:

3.1 Electrode impedances must be checked prior to recording. They should be balanced and between 100 and 5000 ohms. Values should be saved with the recording and available for review.

3.2 Impedances should be checked during recording with the output displayed on the tracing, particularly in the event of artefact.

4.0 MONTAGES:

4.1 The use of longitudinal bipolar, transverse bipolar and referential montages is recommended for routine, clinical EEGs.

4.2 The use of additional or special montages is encouraged to enhance localization and signal appreciation.

4.3 Each montage should display a minimum of 16 but preferably 21 channels of simultaneous EEG signals.

4.4 Electrode arrays should be as simple as possible. Bipolar connections should run in straight, unbroken, anterior-to-posterior or transverse directions with equal inter-electrode distances.

4.5 Anterior-to- posterior and left-above-right orders of derivations are recommended.

4.6 Each montage is to be fully annotated with the electrodes at each derivation specified.

4.7 When contamination of the reference occurs in the recording of a referential montage, another reference site must be chosen. The change should be clearly noted on the EEG.

4.8 Each montage should be recorded for a minimum of 2 minutes. When circumstances warrant, the time may be shortened at the technologist's discretion.

4.9 Montage reformatting in record review mode is recommended to enhance signal appreciation.

5.0 ANNOTATIONS:

5.1 Sensitivity and filter settings, eyelid and head positions, and level of consciousness should be noted at the beginning of each montage.

5.2 Technical, clinical and behavioural changes should be indicated on the recording at the time of their occurrence.

5.3 The following should be documented on the recording at the time of their occurrence:

- signals or commands to the patient;
- the presence or absence of clinical responses to stimuli;
- the onset and conclusion of activation procedures; and
- movement.

5.4 Abbreviations used for annotation should be standardized within each laboratory.

6.0 SENSITIVITY SETTINGS:

6.1 A standard sensitivity setting of 7uV/mm is recommended. Sensitivity adjustments should be made to allow recorded signals to be free from amplifier blocking and signal distortion. Appropriate adjustments also should be made in order to record low voltage signals. (Note: Some digital recording systems measure amplitude as peak-to-peak values. Sensitivity is not expressed in uV/mm.)

6.2 Altering sensitivity settings in review mode is recommended to enhance signal appreciation.

7.0 FILTER SETTINGS:

7.1 Filter settings should allow accurate signal reproduction between 0.1 – 100 Hz.

- 7.2 The low frequency (high-pass) filter should not exceed 0.5 Hz or 1.0 Hz (-3 dB) for the majority of the recording.
- 7.3 Minimally, the high-frequency (low-pass) filter should be set at 70 Hz (-3 dB) for the majority of the recording.
- 7.4 Technologists are encouraged to broaden frequency bandwidths where feasible by reducing the recommended low frequency filter setting and/or increasing the suggested high frequency filter setting.
- 7.5 During recording, making selective filter setting changes is encouraged to improve signal detection.
- 7.6 Changing filter settings in review mode is recommended to enhance signal appreciation.
- 7.7 The 60 Hz (notch) filter should not be used in routine clinical settings. Its use should be restricted to hostile recording environments (i.e. intensive care units) where 60 Hz interference cannot be readily eliminated. Use of the notch filter does not replace good recording technique.

8.0 TIME BASE / SWEEP SPEED:

- 8.1 A time base/sweep speed of 30 mm/sec should be used for the majority of the recording.
- 8.2 Slower or faster time base/sweep speeds should be used when clinically or electrographically indicated.
- 8.3 Changing the time base/sweep speed in review mode is recommended to enhance signal appreciation.

9.0 LENGTH OF RECORDING:

- 9.1 Minimally, the baseline EEG (resting record) should consist of 20-minutes of artefact-free recording. Longer recording times are required to include hyperventilation, photic stimulation, spontaneous sleep and other specialized procedures.
- 9.2 Spontaneous sleep should be encouraged and captured when circumstances permit.

- 9.3** When the recording is dominated by sleep, a period of alert wakefulness should be acquired.

10.0 RESPONSE TESTING:

- 10.1** During wakefulness, periods of eye opening and closure should be recorded in each montage.
- 10.2** Eye opening and closure can be omitted during drowsiness and when sleep is encouraged.
- 10.3** In stuporous or comatose patients, and those with an invariable EEG pattern, various stimuli (visual, auditory, somatosensory, painful) should be applied during the recording.
- 10.4** Response testing should be carried out systematically in the event of either clinical seizures or electrographic seizures lacking overt behavioural changes. Simple motor responses, verbal probe recall and serial subtraction are appropriate tasks.

11.0 EXTRA-CEREBRAL MONITORING:

- 11.1** The electrocardiogram (EKG) should be recorded during every EEG and is essential when syncope or transient ischemic attacks are suggested by clinical history or when EKG artefact is prominent.
- 11.2** The electro-oculogram (EOG) should be recorded during every EEG to distinguish between frontal abnormality and eye movement artefact. Sites for the placement of EOG electrodes must be identified on the recording and labels should be standardized.
- 11.3** Additional physiological monitors should be used where appropriate, including respiration and the electromyogram (EMG).

12.0 VIDEO MONITORING

- 12.1** If available, simultaneous, video monitoring of the patient is recommended in order to capture clinical events. It should be done according to laboratory protocol.

D) ACTIVATION

1.0 HYPERVENTILATION:

- 1.1** Hyperventilation should be performed for 3 minutes unless clinically contraindicated. Contraindications include:
- severe cardiac or pulmonary disease;
 - exertion-induced asthma;
 - sickle cell disease;
 - intra-cerebral hemorrhage and other cerebro-vascular disorders;
 - inability to comprehend or execute the task due to mental incapacity (i.e. intellectual disability, dementia); and
 - non-compliance.
- 1.2** When absence seizures are suspected or to augment irregularities arising during hyperventilation, the protocol should be prolonged and/or repeated according to laboratory standards.
- 1.3** Elapsed time of hyperventilation should be documented in 30-second intervals.
- 1.4** Qualitative assessment of patient effort during hyperventilation should be documented on the recording.
- 1.5** The EEG should be recorded for at least 1 minute before and 2 minutes after hyperventilation, preferably on the same montage.

2.0 PHOTIC STIMULATION:

- 2.1** Intermittent photic stimulation (IPS) should be performed in accordance with “*Guidelines for Visual-Sensitive EEG Testing*”, 2008 as endorsed by the Canadian Society of Clinical Neurophysiologists (CSCN) and adopted by CAET, Inc.
- 2.2 Clinical Considerations:**
- 2.2.1** IPS always should be done when:
- an asymmetry of the alpha rhythm exists or when background abnormalities over the posterior head regions appear during the resting record;
 - children present with neuro-developmental regression (i.e. ceroid lipofuscinosis); and

- seizures/epilepsy are suspected, particularly in the pediatric age group (with the exception of neonates)
- in neonates who have myoclonic seizures; and
- in the elderly whose clinical problems include seizures or neuro-cognitive decline.

2.2.2 IPS should not be done when the patient is in **clinical** status epilepticus.

2.2.3 IPS can be performed when the EEG shows considerable inter-ictal epileptiform features and when **electrographic** status epilepticus occurs (without clinical correlates). Under such circumstances, the electroencephalographer should be consulted prior to performing IPS.

2.2.4 All women of child-bearing age should be asked if they are pregnant. IPS may be performed with the approval of the patient's obstetrician or neurologist. When there is uncertainty, IPS may be omitted but the reason for so doing should be documented.

2.2.5 Caution should be exercised in patients presenting with alcohol or drug withdrawal or who are of known photosensitivity.

2.3 Recommended Intermittent Photic Stimulation Procedure:

2.3.1 The patient may be seated or recumbent and preferably alert.

2.3.2 The lamp distance from the nasion should be 30 cm.

2.3.3 The ambient light should be dim. Lighting should be standardized for consistency.

2.3.4 IPS must not take place within 3 minutes of hyperventilation to avoid late effects of over-breathing.

2.3.5 The following frequencies should be used in sequence: 1, 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 60, 50, 40, 30, 25, and 20.

2.3.6 Flashes should occur in trains of 10 seconds (per frequency) with an interval of at least 7 seconds between frequencies.

- 2.3.7** The first 5 seconds of each flash train should occur with the patient's eye open and directed at the lamp's centre. The patient's eyes should be closed for the remaining 5 seconds.
- 2.3.8** In the event of objective or subjective events, the technologist should activate an event marker or otherwise document the occurrence on the tracing.
- 2.3.9** Attempts to confirm sensitivity to a particular frequency should be separated in time to prevent frequency specific habituation of the response.
- 2.3.10** Photic stimulation should be stopped immediately if any generalized epileptiform activity occurs.
- 2.3.11** EMG electrodes may be necessary to detect myoclonus during a photoparoxysmal response (PPR).
- 2.3.12** If IPS is discontinued prematurely or omitted, reasons should be documented on the recording and in the technical report.

3.0 SPONTANEOUS SLEEP:

- 3.1** Spontaneous sleep should be recorded whenever possible and the opportunity for sleep should be enhanced by periods of unstimulated recording.
- 3.2** Bipolar and referential montages which include midline derivations should be used during drowsiness and sleep.
- 3.3** A minimum of 10 minutes of spontaneous sleep recording should be acquired before the patient is awakened.

4.0 SLEEP DEPRIVATION:

- 4.1** At the time of appointment scheduling, the patient should be advised of the risks of driving in a sleep-deprived state. Alternate travel arrangements should be recommended.
- 4.2** When clinically indicated, sleep deprivation should be performed according to laboratory protocol.

4.3 At least 40 minutes of artefact-free recording should be obtained. The test also should include a period of wakefulness plus hyperventilation and photic stimulation.

5.0 SPECIAL PROCEDURES:

5.1 Special procedures such as ocular compression, carotid sinus massage and carotid artery compression place the patient at risk, necessitating informed consent. These should be carried out in a hospital under the supervision of a qualified physician with adequate resuscitating equipment at hand. The technologist should be well-versed in the protocols.

6.0 SEDATION:

6.1 Sedation is not recommended for routine EEG recording. When clinically warranted, only qualified healthcare professionals, in keeping with hospital and professional standards of practice, should undertake sedation administration and patient monitoring.

E) INFECTION CONTROL:

1.0 INFECTION CONTROL:

1.1 The technologist should comply with Health Canada, OSET, institutional and laboratory standards for infection control. These standards cover: principles of disease transmission prevention, universal precautions and isolation/reverse-isolation techniques.

1.2 The prudent use of an abrasive gel is recommended for lowering impedances. In so doing, the skin must not be broken.

1.3 As a minimum, universal precautions must be observed. Appropriate cleaning, disinfection or sterilization of electrodes and accessories is mandatory between patients.

1.4 In the event of suspected or confirmed communicable disease, additional precautions must be undertaken according to established infection control standards. Such illnesses include but are not restricted to: viral hepatitis; Creutzfeld-Jacob (CJD); Gerstmann-Straussler-Scheinker Syndrome (GSS); Acquired Immunodeficiency Syndrome (AIDS); Human Immunodeficiency Virus (HIV); Methicillin-resistant

Staphylococcus Aureus (MRSA); and Vancomycin-resistant Enterococcus (VRE).

- 1.5 In the presence of head lice, a non-urgent EEG should not be performed. The procedure should be rescheduled after the patient has received successful treatment. When testing is unavoidable, appropriate disinfection/cleaning of the electrodes, equipment and recording environment is required.

F) SAFETY:

1.0 WORKPLACE HEALTH AND SAFETY:

- 1.1 The technologist should ensure electrical safety of equipment and patients. Routine maintenance, electrical safety checks and appropriate grounding (instrument and patient) are essential.
- 1.2 The technologist should know and comply with WHMIS (Workplace Hazardous Materials Information System) standards in the handling, storage and disposal of hazardous workplace materials.
- 1.3 The technologist should apply Occupational Health and Safety principles to work environment practices to ensure a hazard-free recording environment.
- 1.4 The technologist should follow appropriate reporting procedures of incidents, injuries, and potential safety concerns.
- 1.5 The technologist should know and comply with institutional policies for response to emergency incidents/codes.

2.0 PATIENT-CENTERED CARE:

- 2.1 The technologist should have the necessary training/certification to administer first aid/basic life support in emergency situations.
- 2.2 The technologist should recognize critical abnormalities and alert appropriate staff. These abnormalities include:
 - status epilepticus;
 - ECG changes;
 - electrographic seizures;

- electrocerebral silence;
- epileptiform activity; and
- unexpected, significant, focal findings.

2.3 The technologist should demonstrate care when working around intravenous lines as well as monitoring and life support devices attached to the patient.

2.4 The technologist should provide a safe environment by:

- using equipment locking mechanisms;
- removing or securing physical obstacles;
- removing known contact irritants and allergens;
- transferring patients safely; and
- ensuring continuous patient supervision.

G) EEG REPORTING AND INFORMATION STORAGE:

1.0 ANALYSING AND REPORTING:

1.1 The EEG technologist should prepare a technical impression of the recording for the electroencephalographer. This preliminary report should reflect the technologist's knowledge of:

- medication effects on the EEG;
- clinical conditions;
- normal and abnormal pattern recognition in relation to patient age and state (i.e. level of consciousness);
- waveform localization; and
- physiological and non-physiological artefacts.

2.0 INFORMATION STORAGE:

2.1 Confidentiality of patient records must be maintained. Report storage should be in compliance with provincial requirements for data retention and medical record policies of the institution.

2.2 Electronic data archiving should be performed routinely according to laboratory and institutional guidelines.

H) TECHNOLOGIST QUALIFICATIONS:

1.0 CERTIFICATION REQUIREMENTS:

1.1 The EEG should be performed by a Registered Electroneurophysiology Technologist (RET) who has received

certification by the Canadian Board of Registration of Electroencephalograph Technologists, Inc. (CBRET).

- 1.2 An RET should meet the requirements of and perform all duties in accordance with the “*Core Entry-to-Practice Competencies for the Profession of Electroencephalography Technology*” – January 2008. Technologists should not engage in duties beyond their scope of practice.
- 1.3 A board certified technologist should supervise non-registered technologists and students.

2.0 CONTINUING EDUCATION:

- 2.1 The EEG technologist should be committed to continuing professional development through independent study and attendance at recommended educational/scientific meetings. Such instruction is offered by:
 - the Canadian Association of Electroneurophysiology Technologists, Inc. (CAET);
 - the American Society of Electroneurodiagnostic Technologists (ASET); and
 - provincial and other societies representing professionals engaged in electroneurophysiology technology.
- 2.2 The technologist should maintain cardiopulmonary resuscitation (CPR) and basic first aid certification through a recognized program.

3.0 PROFESSIONALISM:

- 3.1 Professional conduct should be in keeping with the “*Code of Ethics of the Canadian Association of Electroneurophysiology Technologists, Inc.*” and the “*Core Entry-to-Practice Competencies for the Profession of Electroencephalography Technology*” – January 2008.
- 3.2 The technologist must maintain confidentiality of patient records. Test results must not be divulged to unauthorized individuals (including the patient and/or representative).