**NEURODIAGNOSTIC TECHNOLOGY PROGRAM GRADUATE COMPETENCIES
FOR LONG TERM MONITORING (LTM) ADD-ON**

The following graduate competencies for performing long term monitoring (LTM) have been established as standards for the education of post-secondary students in neurodiagnostic technology (NDT) programs with LTM add-on to demonstrate entry level competency in the LTM areas identified below.

Entry-level competency is evidenced by a graduate's knowledge and ability in the following areas:

1) **Demonstrating the technical skills in long-term monitoring by:**
   a) following American Clinical Neurophysiology Society (ACNS) and international guidelines for head measurement (10/20 or 10/10 international systems) of electrode placement;
   b) applying electrodes using the appropriate application method (e.g., paste, collodion, or electrode caps);
   c) ensuring electrode security and integrity;
   d) following policies for infection control;
   e) ensuring electrodes and other direct patient contact supplies are cleaned and disinfected as documented in ASET infection control position statement;
   f) verifying and documenting sedation is ordered by the attending physician and administered by the resident or the staff nurse, and assisting nursing staff in monitoring the patient appropriately;
   g) following patient safety protocols, especially those for seizure;
   h) maintaining Cardiopulmonary Resuscitation (CPR) certification and following the hospital code for Cardiorespiratory arrest;
   i) following the unit procedures for high patient acuity (severity of the patient's condition), e.g., respiratory distress or arrest codes, contagious diseases, death;
   j) recognizing artifacts and minimizing, or when possible, eliminating artifact on recordings in all electrically hostile units such as the operating room (OR);
   k) reformatting data and applying data reduction techniques;
   l) using computer operations and networking sufficiently to perform basic troubleshooting and to report findings to IT support services;
   m) creating custom montages using implanted electrodes or additional non-standard electrodes;
   n) recognizing EEG seizure activity, and conducting seizure interview and technical neuroassessment during seizures;
   o) alerting the nurse of the occurrence of subclinical and clinical seizure activity;
   p) recognizing and acting appropriately when a patient experiences a respiratory or cardiopulmonary arrest, initiating CPR procedures as needed;
   q) completing and maintaining patient documentation for charges, statistics, and medical records; and,
   r) demonstrating supportive behaviors necessary for age-specific care.

2) **Demonstrating an understanding of LTM by:**
   a) using medical terminology and accepted abbreviations in LTM;
   b) identifying basic electricity and electronic concepts of LTM equipment;
   c) applying basic safety practices related to the patient and the patient's LTM biomedical equipment;
   d) explaining basic functional neuroanatomy and neurophysiology relevant to LTM;
   e) recognizing anatomical correlation of EEG waveforms;
   f) recognizing electrographic correlates of clinical conditions such as generalized tonic-clonic seizures, complex partial seizures, and nonepileptic events;
   g) describing seizure seminology; and,
   h) demonstrating infection control standards (sterile techniques regarding patient and equipment);

3) **Recognizing the indications for LTM by:**

a) identifying the diagnosis of epilepsy;
b) classifying and characterizing seizures;
c) quantifying seizures; and,
d) recognizing the difference between recordings from surface or implanted electrodes to localize

4) Performing LTM recording options by:
a) using scalp electrodes without video, continuous trace EEG;
b) applying electrodes with video;
c) adding scalp and/or sphenoidal electrodes without video; and,
d) applying scalp and/or sphenoidal electrodes with video.

5) Demonstrating the details of LTM instrumentation by:
a) identifying various types of recording and storage media;
b) explaining concepts of digital recording, including appropriate sampling rates, aliasing, Nyquist frequency, sampling skew, amplitude resolution, horizontal resolution (analysis time), and digital video specifications;
c) discussing the effects of recording parameters (filters, gain/sensitivity) on EEG waveforms;
d) verifying electrode impedance test;
e) ensuring electrical safety of equipment;
f) using and explaining automatic seizure detection software including the application of basic algorithms used for detection;
g) explaining parameters used in event detection, and their effects;
h) using a computer to organize file structures and maneuvering around a menu environment;
i) applying and adjusting appropriate calibration for analog or digital recording;
j) describing the technique of reformatting system references; and,
k) explaining audio/video instrumentation, including digital video technology.

6) Performing duties specific to LTM by:
a) using electrode application techniques appropriate for extended monitoring and for patients in critical care settings;
b) using appropriate activation procedures per physician's order such as photic stimulation, hyperventilation, sleep deprivation, and /or any patient specific activation;
c) reviewing events detected by automated spike/seizure detection system; and,
d) printing EEG from stored computer data.

7) Selecting appropriate recording parameters and customizing these parameters based on the case by:
a) reviewing, analyzing, and extracting clinical events from recorded data;
b) adjusting video recording system and troubleshooting problems;
c) using safety precautions when caring for patients having seizures;
d) assisting in the care and transfer of patients; and,
e) transporting recording equipment as needed.

8) Recognizing various types of electrodes used in the clinical setting, including:
a) scalp – disk;
b) scalp – needle;
c) sphenoidal;
d) monitoring electrodes (e.g., eye movement, EMG, respiratory);
e) intracranial electrodes;
f) subdural strips, grids, cylinders;
g) epidural strips, grids;
h) depth electrodes; and,
i) different electrode metals and their effects on EEG recording.

9) Demonstrating the verification process to check the integrity of LTM equipment by:
   a) calibrating system amplifiers;
   b) ensuring audio/video equipment is working properly; and,
   c) verifying patient event alarms.

10) Acquiring information and assisting in evaluating the patient and his/her needs prior to the procedure by:
   a) reading medical records;
   b) interviewing patient;
   c) interviewing family/friends;
   d) discussing with referring physician;
   e) viewing previously recorded data;
   f) determining and accommodating the patient's age-specific needs (e.g., mental age, state, comprehension level, disability, and/or special needs);
   g) providing appropriate patient education including expectations and guidelines while in the monitoring unit and explanation of technical procedures, such as limitation of movement, use of event signal devices, continuous audio/video recording, and some loss of privacy;
   h) answering questions relating to the LTM monitoring procedure; and,
   i) answering questions (education/ information) related to subsequent testing procedures, Wada, cEEG, PET, FMRI, SPECT, Neuropsychological testing, etc.

11) Preparing a basic data sheet that includes:
   a) patient demographic information (i.e., name, age, ID number);
   b) procedure information: number, recording time, date, technologist's initials;
   c) significant relevant medical history and clinical findings specific to procedure;
   d) seizure or event types, description, duration, and frequency, first and last event;
   e) patient's mental, behavioral, consciousness, and neuro-assessment baseline states;
   f) all patient medications, drug levels if available; and,
   g) results of studies relevant to LTM (PET, cEEG, MRI, neuropsychology, SPECT).

12) Following a method of electrode application that includes:
   a) identifying appropriate method of electrode application;
   b) checking supplies, number of electrode jackboxes, interconnector cables, and amplifiers for each patient;
   c) determining set-up and recording protocols including montage derivations appropriate for the patient;
   d) using standard precautions during patient preparation;
   e) using physician-ordered placement of additional electrodes;
   f) ensuring security and integrity of electrodes for an extended period of time;
   g) measuring the patient's head according to the International 10/20 System of electrode placement;
   h) cleaning patient's scalp and skin prior to electrode application;
   i) maintaining sterility of incision and implant site;
   j) discarding or autoclaving electrodes that come in contact with body fluids;
   k) placing appropriate recording reference and ground electrodes in digital recording systems and using spares whenever necessary; and,
   l) assessing the patient's potential for skin breakdown and taking steps to minimize such a risk.

13) Obtaining a baseline recording from all intracranial electrodes used during the LTM procedure by:
   a) verifying electrode recording and artifacts;
   b) using appropriate recording and stimulus parameters;
   c) applying techniques that enhance or clarify the EEG abnormality (e.g., adding electrode derivations and montages);
   d) using sequential montage arrangement going from left to right, central to temporal, anterior to posterior, superior to inferior;

e) determining adequacy of scalp site used for recording reference location;
f) documenting and verifying electrode input descriptors, placement and equipment associations (which electrode name from what anatomical area, plugged into which jack input); and,
g) following all recording standards set by ACNS Guidelines for LTM.

14) Identifying and eliminating or reducing artifacts contaminating the recording of EEG and video by:
a) checking the quality of the signal;
b) setting equipment gain factors and amplifier parameters appropriately;
c) performing impedance checks periodically and when any suspicion of high impedance and adjusts appropriately;
d) recognizing artifact as physiologic or non-physiologic;
e) identifying source of artifact and corrects or eliminates;
f) securing headbox/transmitter system to protect against disconnection during seizures or patient events;
g) ensuring proper grounding of patient and equipment; and,
h) recognizing artifacts related to networking and loss of connectivity.

15) Performing bedside testing of patients during and after seizures by:
a) Obtaining baseline testing appropriate to patient's age and level of development;
b) assessing patient's language function by having patient read standardized phrases or name pictures during ictal and postictal states and comparing results to baseline testing;
c) giving patients simple and complex commands during LTM procedures; and,
d) testing memory and cognitive function relative to LTM.

16) Acquiring and reviewing selected data to discuss with the clinical neurophysiologist by:
a) reviewing complete data from monitoring period by some form of fast review method or reviews data extracted by a computerized automatic event detection system;
b) extracting portions of electrographic data for inter-ictal (both wake and sleep) and ictal samples;
c) identifying and accurately describing the chronology of clinical correlates during an event;
d) selecting 2-3 minutes of baseline recording before and after an event;
e) documenting seizure/event, clinical behavior, time, and date;
f) documenting neuro-assessment completion and time;
g) documenting LTM review on technical worksheet including:
   (i) patient identification;
   (ii) recording parameters and system integrity check;
   (iii) electrode placement including additional electrodes, input descriptors;
   (iv) diagram of implanted electrodes;
   (v) patient room and equipment used;
   (vi) any system malfunction and troubleshooting steps;
   (vii) mapping parameters and findings;
   (viii) medication dosages and when anticonvulsants were tapered off or any other changes; and,
   (ix) clinical events, times, behavioral correlates, patient assessment;
h) transferring data between local and network drives from acquisition to review station for data review and permanent storage;
i) archiving selected portions, such as patient events, for permanent storage;
j) preparing a master tape of video and electrographic data;
k) printing out and labeling all events based on laboratory protocol;
l) reviewing daily chart notes regarding patient; and,
m) interviewing patient or relatives daily to determine if events occurred and any unusual clinical behavior to confirm sensitivity of event detection system.

17) Completing the LTM procedure by:

a) disconnecting patient from monitoring equipment, removing scalp electrodes from patient, and cleaning scalp, noting and taking care of any skin breakdown;
b) cleaning electrodes and patient equipment; and,
c) replenishing and maintaining adequacy of supplies for the LTM procedure.

18) Participating in bedside or intraoperative localization of language and sensorimotor cortex:
a) assisting the physician during motor mapping to identify specific areas of motor function;
b) observing the patient carefully and documenting movement or sensation during cortical mapping; and,
c) preparing the equipment for cortical mapping to include:
   (i) accurately connecting appropriate cortical inputs for electrical stimulation;
   (ii) preparing biphasic electrical stimulator for use, including verifying settings;
   (iii) selecting and verifying current intensities for mapping;
   (iv) documenting intensities used and results of stimulation;
   (v) noting thresholds for after-discharges;
   (vi) calibrating EEG equipment prior to recording; and,
   (vii) selecting appropriate timebase, sensitivity and bandpass setting to record after-discharges.

19) Initiating cortical recording in the operating room {Electrocorticography (ECoG)} by:
   a) preparing patient for EcoG by explaining recording procedure and applying appropriate reference/ground electrodes;
   b) calibrating and setting up EEG recording equipment using appropriate filters and sensitivity settings;
   c) selecting montages based on electrodes applied to cortex by the neurosurgeon before and during resection;
   d) identifying and troubleshooting artifacts encountered during the recording;
   e) maintaining and ensuring completeness of supplies used for ECoG; and,
   f) documenting electrographic findings during the recording, completing paperwork for submission to the clinical neurophysiologist.

20) Performing the Wada Test by:
a) preparing equipment and supplies needed for recording in the special procedure;
b) applying electrodes using the International 10/20 System of electrode placement based on ACNS guidelines;
c) recording a 10-minute baseline with appropriate montage and filter settings;
d) making notations on the recording as to the time of the injection of medicine, behavioral correlates and any other changes observed during the procedure; and,
e) completing all paperwork associated with the Wada testing procedure.

21) **Performing home ambulatory 24-hour EEGs by:**
a) preparing equipment;
b) preparing and educating the patient on procedure;
c) applying electrodes using the appropriate application method (e.g., paste, collodion, electrode cap); and,
   (i) explaining take-home diary, event button, and computer;
   (ii) wrapping head or having patient bring hat, scarf for travel home; and,
   (iii) explains safety precautions;
d) completing the study by:
   (i) removing electrodes and cleaning scalp;
   (ii) correlating patient diary and verbal 24-hr history with acquired data;
   (iii) identifying events detected and those signaled by patient;
   (iv) identifying artifacts; and,
   (v) printing events and transferring event data for review and interpretation by clinical neurophysiologist.

22) Performing continuous EEG (cEEG) by:
   a) preparing equipment for the cEEG environment;
   b) preparing and educating patient, ICU/staff and their family on procedure:
      (i) applying electrodes with collodion technique;
      (ii) explaining documentation needed;
      (iii) explaining safety precautions; and,
      (iv) ensuring that cEEG is recording and eliminating or monitoring artifact;
   c) discontinuing the cEEG:
      (i) removing electrodes and cleans scalp;
      (ii) correlating patient worksheet with acquired data;
      (iii) identifying events detected and those signaled by patient/staff/family;
      (iv) identifying artifacts; and
      (v) printing events and transferring event data for review and interpretation by clinical neurophysiologist

23) Preparing SPECT Scan by:
   a) disconnecting equipment so patient can have the SPECT procedure; and,
   b) reconnecting EEG recording equipment after SPECT scan, ensuring the integrity of electrodes and system once patient is reconnected.