

Critical Care Continuous EEG (CCEEG/LTM) Care Guideline



Inclusion Criteria: Acute Encephalopathy and/or Brain Injury (Specific Indications Below)

Exclusion Criteria: Admission to Acute Care Units

NOTE: ALL CCEEG REQUESTS REQUIRE CONCOMITANT NEUROLOGY CONSULTATION

CCEEG/LTM Indication	Initiation Within (Hours) [†]	Comments	Duration (Hours) / Discontinuation (DC)
DDx of recurrent unexplained events (abnormal movements, vital sign fluctuations, etc.)	6	Push-button marking of event(s) by ICU staff required; Multiple events may be needed for adequate DDx	12-48; DC after adequate DDx of events
Post convulsive SE with persistent encephalopathy (i.e., screen for NCS/NCSE)	3	Patient typically stuporous or comatose, not improving, and/or paralyzed	24-48; Recommend ≥24hr sz-free to DC
Acute and/or fluctuating encephalopathy of unclear etiology	6	Including systemic disease, recent cardiac or neurosurgery, known epilepsy, etc.	24-48; Recommend ≥ 24hr sz-free to DC
Sepsis-associated encephalopathy	6	Significant and sustained encephalopathy	24-48; Recommend ≥ 24hr sz-free to DC
Acute neurological injury (stroke, CNS hemorrhage, CNS infection, TBI) with seizure risk	6 (3 if ↑↑ suspicion for NCS)	Anticipated urgent/semi-urgent imaging should be completed before LTM initiation	24-48; Recommend ≥ 24hr sz-free to DC
Hypoxic-ischemic encephalopathy (HIE) following cardiac arrest (as part of post-resuscitation mgmt.)	3 (POC O/N as available)	See above imaging comment. Please note LTM for HIE is not equivalent to/sufficient for determination of possible brain death	24-48; Recommend ≥ 24hr sz-free to DC
Neonatal HIE (Hypothermia protocol, aka cooling protocol)	3 (POC O/N as available)	LTM during hypothermia +/- rewarming, per Neuro-NICU direction. Neuro-NICU to consult when available.	72-96; DC upon rewarming for DOL 4 imaging
ECMO	6	May extend duration based upon clinical circumstances	DC after 72hr if no change in background
Neonates (≤ 44 weeks adjusted gestational age) following cardiac surgery with bypass	6 (or post-op)	If notified in advance, lab will initiate immediately post-op while patient is still sedated in CVICU	48; Recommend ≥ 24hr sz-free to DC
Burst suppression management of intracranial hypertension or status epilepticus	3	IV ASM dose titration. ICU team may manage with direct EEG interpretation	PRN; DC after ≥ 24hr sz-free with adequate anesthetic wean

[†]Overnight (O/N) requests for non-emergent CCEEG will be prioritized to early AM, as clinically appropriate; POC EEG device (e.g., Incereb, VitalEEG, etc.) may be used to expedite certain indications, as available

Initiation Roles[‡]

- ICU MD (Fellow or Attending)
 - Calls Neurology Service for consult and LTM Initiation
- EEG Technologist
 - Initiates LTM per Protocol
 - Assists with Incereb/POC EEG hookup
- Neurology Service
 - Develops Seizure Action Plan (SAP)
 - Approves LTM outside protocol
- Epileptologist on-call as needed

Seizure Notification[‡]

- EEG Technologist
 - Notifies reading Epileptologist or Neurologist, per protocol
- Epileptologist
 - Notifies Neurology Service
- Neurology Service
 - Advises ICU team per SAP
 - Reviews EEG for DDx of ICU reported events
- ICU team (MD/NP)
 - May call Neurology service (not EEG tech/Epileptologist) for DDx of concerning events

Discontinuation[‡]

- LTM is generally DC'ed after 24-48hrs if no seizures and no major changes in patient condition.
- If seizures occur, LTM is continued until ~24hrs after last seizure, unless otherwise specified per goals of care.
- LTM may be extended if clinically necessary.
- DC requires agreement among epileptologist, ICU/Neuro MDs, and EEG tech
- Non-emergent overnight DC is strongly discouraged

[‡]Please refer to appendices below for more detailed information

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Assessment / Interventions Staff Roles and Responsibilities

Phase of CCEEG/LTM Monitoring	Roles/Responsibilities	Documentation
Requesting Initiation	<p>ICU MD/NP</p> <ul style="list-style-type: none"> - Call Neurology Service for consult and LTM initiation, to be initiated within protocol parameters. - Clinically urgent CCEEG studies will be initiated within 3 hours, typically necessitating home technologist call-back overnight. - Overnight requests for non-emergent LTMs will be prioritized to early AM, as clinically appropriate, except on nights when a second/multiple technologists are scheduled in-house. - POC EEG device (e.g., Incereb, VitalEEG, etc.) may be used to expedite certain indications, as available <p>Neurology Service</p> <ul style="list-style-type: none"> - Confirm no urgent imaging/procedure needed - Fellow/APP calls EEG technologist to initiate LTM - Neurology attending reviews/approves requests outside of protocol parameters - Epileptologist approval is not necessary 	<p>ICU Service</p> <ul style="list-style-type: none"> - Describe event(s) of concern, if any <p>Neurology Service</p> <ul style="list-style-type: none"> - Case summary and consult request - Develop seizure action plan (SAP) - Consider sharing SAP with EEG technologist if appropriate - Add patient to consult list <p>EEG Technologist</p> <ul style="list-style-type: none"> - Add deferred overnight studies to expedited AM hook-up list, if applicable
Hookup	<p>EEG Technologist and ICU RN</p> <ul style="list-style-type: none"> - Work together to document skin observation and to apply electrodes (RN involved in POC EEG systems) - Technologist performs activating procedures, per lab guidelines - Patient/parent given event log (if applicable) 	<p>EEG Technologist</p> <ul style="list-style-type: none"> - Baseline skin observation - Changes/limitations in electrode placement (e.g., avoiding craniotomy, etc.) - Deviations from protocols
Active Monitoring	<p>Neurology Service</p> <ul style="list-style-type: none"> - Establishes management goals with ICU - Conveys non-urgent EEG data to ICU at least daily, including changes in background (not just seizures) <p>EEG Technologist</p> <ul style="list-style-type: none"> - Works with ICU RN to perform reactivity testing at least daily, skin checks per protocol - Screens EEG and annotates relevant information <p>ICU MD/NP</p> <ul style="list-style-type: none"> - If concern for seizure, the ICU may call the Neurology Service (not EEG technologist or Epileptologist) to obtain an interval / <i>ad hoc</i> review. - ICU team may review EEG tracing independently; Patient-facing monitor turned off to avoid confusion. <p>Epileptologist</p> <ul style="list-style-type: none"> - Reads EEG and renders final interpretation - Communicates seizures and clinically relevant EEG changes to Neurology service in real time - 24/7 support of EEG Technologists - Collaborates with Neurology Service regarding management at least daily (preferably EEG record review) and more often for clinically active patients 	<p>EEG Technologist</p> <ul style="list-style-type: none"> - Skin checks and skin breaks per protocol - Annotate relevant information on EEG tracing, e.g., state changes, artifact sources, technical information (impedance issues, etc.), suspected seizures, events of concern, etc. - Annotations should occur regularly, at least once every 1 hour, per lab protocol. <p>Epileptologist</p> <ul style="list-style-type: none"> - Daily LTM report per guidelines - Daily record review with Neuro service (weekdays)

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Assessment / Interventions Staff Roles and Responsibilities

Phase of CCEEG/LTM Monitoring	Roles/Responsibilities	Documentation
<p>Seizure or Urgent Result Notification</p>	<p>Initial Seizure(s)</p> <p>EEG Technologist</p> <ul style="list-style-type: none"> - Notifies reading Epileptologist <p>Epileptologist</p> <ul style="list-style-type: none"> - Confirms seizure and notifies Neurology service <p>Neurology Service</p> <ul style="list-style-type: none"> - Advises ICU team per seizure action plan (SAP), close follow-up to ensure timely ASM admin - Regularly updates ICU on ongoing management of NCS, NCSE, etc. - May screen EEG for events identified by ICU team <p>ICU MD/NP</p> <ul style="list-style-type: none"> - May call Neurology service (not EEG technologist) for EEG differential diagnosis of concerning events if not already triggered by above notification system <p>Subsequent Seizure(s): <i>In general, notification will resume after prescribed round of treatment plan has been initiated, e.g., after intended ASM load has been given & szs continue</i></p> <p>EEG Technologist</p> <ul style="list-style-type: none"> - May communicate directly with Neurology fellow on night call (bypassing Epileptologist) for previously defined/agreed upon seizure patterns overnight (generally 7P-7A). Notifications are given directly to Epileptologist during day shift. <p>Neurology Service</p> <ul style="list-style-type: none"> - Continue subsequent steps in SAP; Reassess as appropriate <p>Epileptologist</p> <ul style="list-style-type: none"> - Backup EEG technologist and Neurology 24/7/365 	<p>ICU RN</p> <ul style="list-style-type: none"> - Push EEG event button for events of concern - Push EEG event button for medication loads - Document event semiology (clinical characteristics) <p>EEG Technologist</p> <ul style="list-style-type: none"> - Annotate seizure onset and offset on EEG tracing - Annotate treatment associated with push-buttons - Night technologist to establish line of communication with Neurology fellow on night call in advance (Voalte or similar), see QGenda for schedule. - Handoff any pertinent seizure description(s) to night technologist.
<p>LTM Discontinuation</p>	<p>Duration of LTM</p> <ul style="list-style-type: none"> - Duration is determined by clinical context - LTM is generally DC'ed after 24-48 hours if there are no seizures or significant clinical changes - LTM is generally continued ~24 hours after the last seizure <p>Extending LTM</p> <ul style="list-style-type: none"> - LTM may be extended longer if there is ongoing risk for electrographic seizure, evolving acute brain injury/risk, or antiseizure medication is being weaned/adjusted. <p>Early LTM Termination</p> <ul style="list-style-type: none"> - LTM may be terminated more quickly if patient is rapidly improving, EEG background suggests a very low risk of seizure, event of concern is deemed nonepileptic, patient transport is required, or no additional seizure management is indicated, per goals of care. <p>Approval</p> <ul style="list-style-type: none"> - Disconnection must be approved by 1) Epileptologist, 2) ICU (ordering) team, 3) Neuro team, and 4) EEG technologist (after screening EEG up to present time). 	<p>EEG Technologist</p> <ul style="list-style-type: none"> - Document final skin observation - Ensure HV/IPS done, per lab protocol - Notify reading MD of any new events before disconnect. Last read epoch will be annotated with reviewer's initials. <p>Epileptologist</p> <ul style="list-style-type: none"> - Annotate last read epoch with reviewer's initials - Complete final/summary EEG report

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Communication

Figure 1. CCEEG/LTM Initiation Communication Flowchart

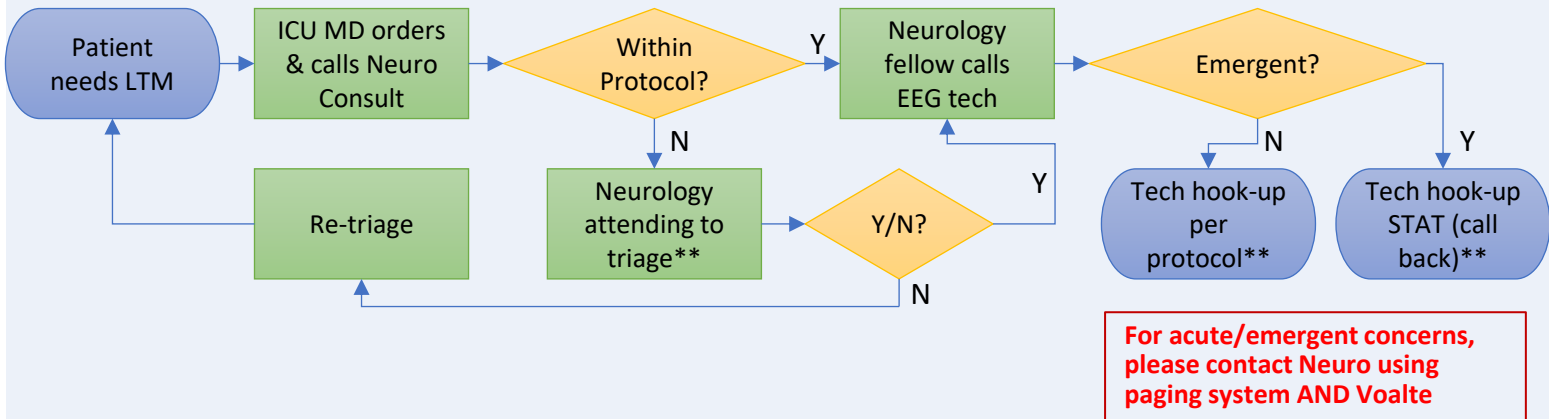


Figure 2. (Concern for) First Seizure Communication Flowchart

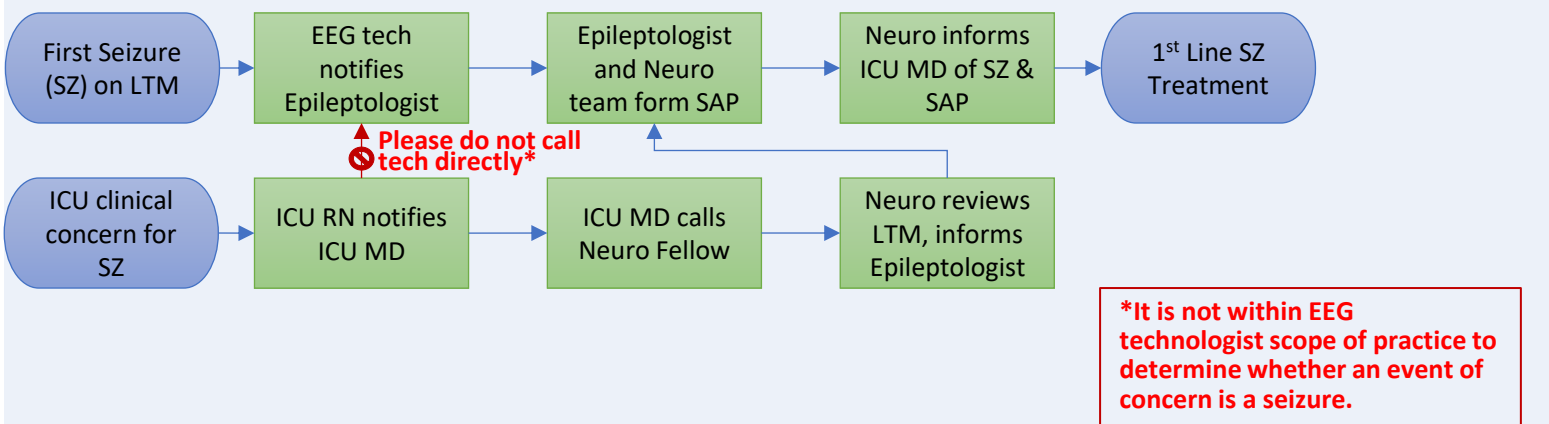


Figure 3. (Concern for) Subsequent Seizure Communication Flowchart

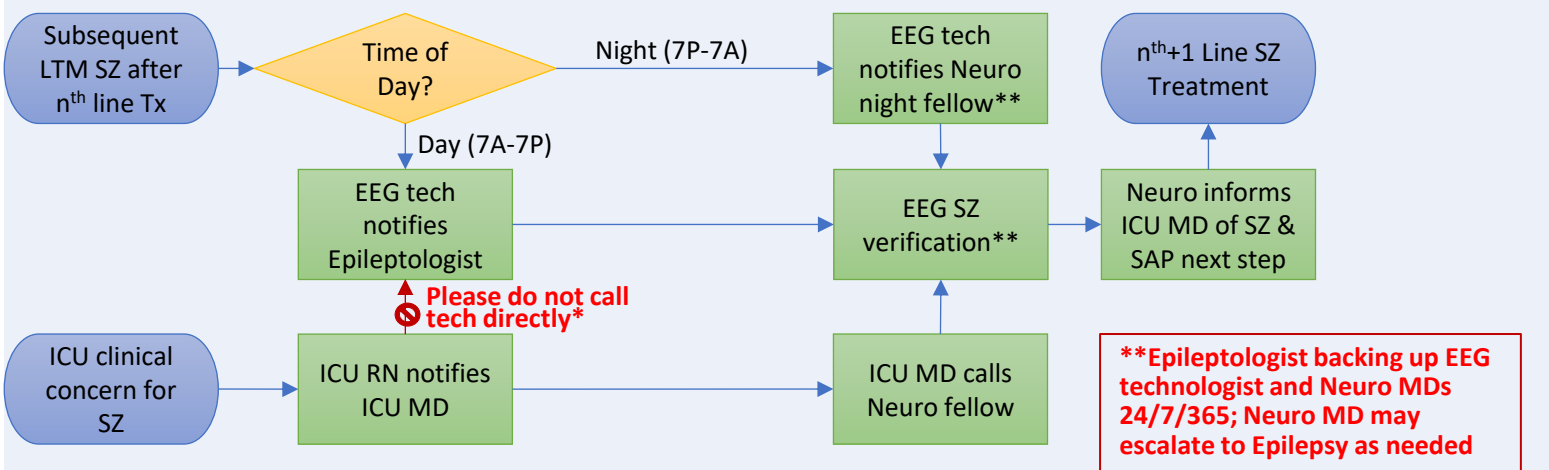
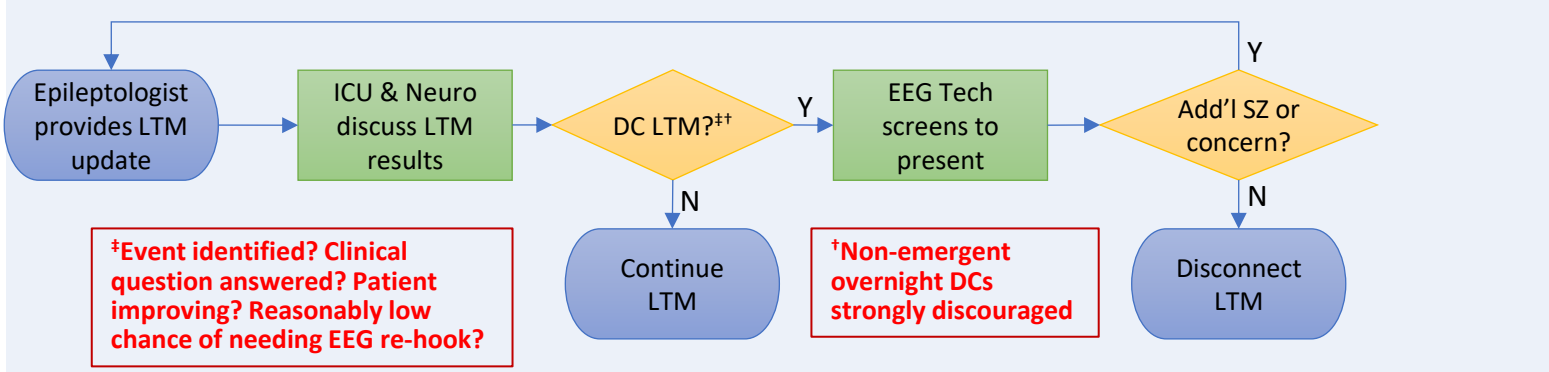


Figure 4. LTM Discontinuation Communication Flowchart



Abbreviations / Definitions

APP: Advanced practice provider

ASM: Antiseizure medication, aka antiepileptic medication (AED)

CCEEG: Continuous Electroencephalogram (EEG) with video, +/- graphical displays of quantitative EEG (QEEG)

CVICU: Cardiovascular intensive care unit

DC: Discontinue

DDx: Differential Diagnosis

DOL: Day of life

ECMO: Extracorporeal membrane oxygenation

EEG: Electroencephalogram

Encephalopathy: Acute brain dysfunction from multiple potential causes, typically manifesting as altered mental state

HIE: Hypoxic Ischemic Encephalopathy

ICU: Intensive care unit

Incereb: A rapid/point-of-care neonatal EEG device applied by bedside healthcare provider

LTM: Long-term Monitoring, synonymous with CCEEG, see above

NCS: Nonconvulsive seizures

NCSE: Nonconvulsive status epilepticus

NICU: Neonatal intensive care unit

PACU: Post-anesthesia Care Unit

PICU: Pediatric intensive care unit

POC: Point-of-care

POC EEG: A generic term for a rapid EEG device applied by bedside healthcare provider, not EEG technologist

QEEG: Quantitative EEG, a graphical display of EEG features over time

SAP: Seizure action plan, a shared plan among treatment teams in the event seizures arise

SE: Status Epilepticus

SZ: Seizure

TBI: Traumatic Brain Injury

VitalEEG: A rapid/point-of-care (POC) EEG device applied by bedside healthcare provider

References

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