JOHNS HOPKINS ALL CHILDREN'S HOSPITAL
INSTITUTE FOR BRAIN PROTECTION SCIENCES

Status Epilepticus Clinical Pathway

JOHNS HOPKINS
All Children's Hospital

Johns Hopkins All Children's Hospital

Status Epilepticus Clinical Pathway

Table of Contents:

1. Rationale
2. Background
3. Diagnosis
4. Clinical Management
    a. Status Epilepticus Pathway
5. Inpatient Status and Admission / Discharge Criteria
    a. Inpatient Status Admission Pathway
6. Outcome Measures
7. References

Last updated: December 22, 2025

Owners: Danielle Hirsch, MD; Richard Tang-Wai, MDCM, FRCPC, FAES

This pathway is intended as a guide for physicians, physician assistants, nurse practitioners and other healthcare providers. It should be adapted to the care of specific patient based on the patient's individualized circumstances and the practitioner's professional judgment.

Johns Hopkins All Children's Hospital

Status Epilepticus Clinical Pathway

Rationale:

This clinical pathway was developed by a consensus group of Johns Hopkins All Children's Hospital (JHACH) Neurologists/Epileptologists, Emergency Medicine Physicians, Advanced Practice Providers, Hospitalists, Intensivists, Nurses, and Pharmacists to standardize the management of children treated for status epilepticus (SE). The following clinical issues are addressed:

- When to evaluate for SE
- When to consider admission for further evaluation and treatment of SE
- When to consult Neurology, Hospitalists, or Critical Care Team for further management of SE
- When to obtain further neuroimaging for SE
- What ongoing therapy patients should receive for SE

Background:

SE is the most common neurological emergency in children and has the potential to cause substantial morbidity and mortality.[1] The incidence among children ranges from 17 to 23 per 100,000 annually.[2] Prevalence is highest in pediatric patients from 0 to 4 years of age.[3]

This pathway acknowledges the most current definition of SE as a continuous seizure lasting more than five minutes or two or more distinct seizures without regaining awareness in between.[3] This shift from the definition of SE being 30 or more minutes of continuous seizure activity has been supported by the American Epilepsy Society and the American Neurocritical Care Society. Pharmacoresistance and permanent neuronal injury have been suggested by animal data from the effects of SE occurring before the traditional definition.[4] When comparing several different pediatric SE protocols, it was found that more timely SE treatment is recommended since prior studies have shown that appropriate escalation of medications and prompt administration may increase the probability of seizure cessation.[5] In fact, there is a 5% cumulative increase for the episode to last longer than 60 minutes with each minute that passes between the onset of SE and arrival at the Emergency Center (EC).[6]

Within the first five minutes, it should be determined if seizures are epileptic or non-epileptic, as well as whether a benzodiazepine has been administered. Intravenous (IV) lorazepam and diazepam are successful at stopping seizures within five minutes [level of evidence: A].[7] Intramuscular (IM) midazolam, intranasal (IN) midazolam, rectal (PR) diazepam, and buccal midazolam are most likely efficacious at stopping SE [level of evidence: B].[7] There is inadequate evidence to support the use of sublingual, PR, and IN lorazepam, valproic acid (VPA), levetiracetam, phenytoin, and phenobarbital as first-line agents.[7]

As a second-line therapy, IV levetiracetam, fosphenytoin, or VPA should be considered, followed by IV phenobarbital. Recent data have shown that levetiracetam could be a suitable alternative to phenytoin with a good safety profile for pediatric SE.[8] However, levetiracetam was

not superior to phenytoin for stopping seizures. Overall, VPA is better tolerated than phenobarbital with similar efficacy.[7]

Possible long-term complications of SE other than death affect 15 – 50% of pediatric patients and include cognitive and behavioral problems, secondary epilepsy, and focal neurological deficits. With more adequately treated SE over the last three decades, there has been an improvement in mortality outcomes. More recent studies report mortality rates of 5% in patients less than 1 year and 2% in patients 1 to 19 years of age, compared to 11% of children younger than 15 years previously.[3] Inadequately treated or untreated SE can result in changes in motor activity, progressive changes in the electroencephalogram (EEG) pattern, as well as an increased resistance to treatment and more severe consequences.[4]

Diagnosis:

Diagnosis is made clinically; however, EEG can be diagnostic, and some laboratory findings are indicative. The recent Neurocritical Care Society guideline indicates that initial etiologic testing should include a point-of-care (POC) blood glucose (BG).

Laboratory tests:

Initial laboratory tests:

- POC BG
- Complete blood count with differential (CBC w/ diff)
- Comprehensive metabolic panel (CMP)
- Magnesium (Mg)
- Phosphorus (Phos)
- Anti-epileptic medication levels for patients with established seizures

Depending on the clinical scenario, other diagnostic testing may be required:

- Neuroimaging or lumbar puncture (LP)
- Other laboratory testing: coagulation studies, toxicology screen, human chorionic gonadotropin (hCG), inborn errors of metabolism screening, chromosomal microarray, genetic epilepsy panel
- Continuous EEG

Radiology studies:

Neuroimaging abnormalities have been reported in 30% of children with SE and are described to alter acute management in 24%. A computed tomography (CT) scan is fast and able to detect blood and masses. Magnetic resonance imaging (MRI) of the brain is superior and should be considered when the CT scan is negative.

Central nervous system (CNS) infections are a common cause of acute symptomatic SE. LP should be performed whenever there is a clinical suspicion of infection. Children who are less than 2 years old, immunosuppressed or compromised, or have received recent antimicrobials may present with SE before other clear signs of CNS infection.

EEG should be considered early to guide treatment and establish that seizures have stopped both electrographically and clinically.

- There is increasing data that after convulsive SE terminates, some children have persisting electrographic seizures.
    - Continuous EEG monitoring should be initiated within one hour of SE onset if ongoing seizures are suspected.
- Diagnosing paroxysmal non-epileptic seizures (PNES) by EEG monitoring may avoid continued exposure to antiepileptic medications and pharmacologic coma induction with potential adverse effects.
    - Clinical signs that should increase suspicion of PNES include eyes tightly closed, side-to-side head movements (often fixed to one side in seizures), alternating limb shaking, arching, rotation of the body in multiple directions, and fluctuating course or “stop and go” [9].

Clinical Management:

1. Assess airway, breathing, circulation, disability, exposure (ABCDE), and vital signs (0 – 2 minutes)
2. Non-invasive airway protection and gas exchange with head positioning (0 – 2 minutes)
3. Neurologic examination (0 – 5 minutes)
4. Placement of peripheral IV access for administration of emergent antiepileptic medication therapy and fluid resuscitation (0 – 5 minutes)
5. Intubation if airway or gas exchange is compromised or intracranial pressure is elevated (0 – 10 minutes)

Johns Hopkins All Children's Hospital

Status Epilepticus Clinical Pathway

(FIRST 60 MINUTES)

Inclusion Criteria:
- Patients with seizure > 5 minutes

Exclusion Criteria:
- Neonates < 30 days
- Patients with epilepsy who have a baseline EEG on the ictal-interictal continuum
- Patients with psychogenic non-epileptic attacks

0 – 5 min

Emergency Center Pathway
- Determine prior history of seizures
- Determine if benzodiazepines were administered before arrival to the EC

Inpatient Pathway
- RN to notify the provider that the patient is seizing
  - If unable to contact the provider, initiate a rapid response or code

- Initiate ABCDE, oxygen, continuous pulse oximetry, and cardiorespiratory monitoring
- Obtain IV access, POC BG, CBC w/ diff, and CMP with Mg and Phos
- Obtain antiepileptic levels for patients with established seizures
- Determine if seizure is epileptic or non-epileptic
- Concurrently, consider obtaining further labs (e.g., toxicology screen, hCG) and imaging with fast brain MRI or CT head (if MRI unavailable)
- Correct reversible causes (e.g., hypoglycemia, hyponatremia)

5 – 10 min

Administer lorazepam 0.1 mg/kg/dose IV (max dose: 4 mg/dose)

If no IV access, consider midazolam 0.2 mg/kg/dose (IM) or 0.3 mg/kg/dose (IN) (max dose: 10 mg/dose)

Reassess in 5 minutes: Seizure stopped?

YES

- Monitor patient
- Airway protection
- Consult Neurology
- Continue diagnostic workup from the previous step
- Obtain video EEG if subclinical or focal seizure is suspected
- Consider LP if encephalitis or meningitis is suspected
- Consider initiation of maintenance therapy

NO

10 – 20 min

Repeat a 2nd dose of benzodiazepine **AND** administer second-line medication *(second-line medication should be administered even if the seizure stops after the 2nd dose of benzodiazepine)*

PATIENTS WTH ESTABLISHED SEIZURES:

Consider loading dose* of home medication if IV formulation is available, **OR** initiate second-line medication

OR

NEW ONSET SEIZURES:

Second-line medications (*choose 1*):
- levetiracetam 60 mg/kg/dose IV (max dose: 4,500 mg/dose)
- fosphenytoin 20 mg/kg/dose IV (max dose: 1,500 mg/dose) (excluding Dravet syndrome)
- VPA 40 mg/kg/dose IV (max dose: 3,000 mg/dose) (only patients > 2 years old or patients with known Dravet syndrome)
- If the above is unavailable, consider phenobarbital 20 mg/kg/dose IV (max dose: 1,000 mg/dose)

Consider ordering 2 second-line medications

Reassess in 5 minutes: Seizure stopped?

YES

NO

20 – 60 min

Administer a loading dose of an alternative second-line medication

Reassess in 5 minutes: Seizure Stopped?

YES

NO

Contact Critical Care Team for transfer to PICU and treatment of refractory SE with continuous midazolam or pentobarbital infusion all with continuous EEG monitoring

Abbreviation: PICU, Pediatric Intensive Care Unit

*Consider a smaller loading dose for patients with established seizures on phenytoin, lacosamide, and/or VPA (see below)

Pharmacologic management:

Correct reversible causes:

- Hypoglycemia – provide dextrose:
    - < 5 kg: dextrose 10% 0.2 – 1 g/kg/dose (max dose: 25 g/dose)
    - ≥ 5 kg: dextrose 50% 0.5 – 1 g/kg/dose (max dose: 25 g/dose)
- Hyponatremia – provide sodium chloride 3% hypertonic 5 – 6 mL/kg/dose (max dose: 500 mL/dose)

First-line medications:

- Benzodiazepines are the first-line medication for SE
    - Administer lorazepam 0.1 mg/kg/dose IV (max dose: 4 mg/dose)
    - If no IV access:
        - midazolam 0.2 mg/kg/dose IM (max dose: 10 mg/dose)
        - midazolam 0.3 mg/kg/dose IN (max dose: 10 mg/dose)
- Assess for the administration of previous doses of benzodiazepines before arrival by caregiver, Emergency Medical Services (EMS), or rapid response/code team
- Repeat benzodiazepine dose in 5 minutes if seizure has not resolved

Second-line medications (administer within 5 – 10 minutes of continued seizure activity):

- Medications:
    - levetiracetam 60 mg/kg/dose IV (max dose: 4,500 mg/dose)
    - fosphenytoin 20 mg/kg/dose IV (max dose: 1,500 mg/dose)
        - Excluding Dravet syndrome
    - VPA 40 mg/kg/dose IV (max dose: 3,000 mg/dose)
        - Only for patients > 2 years OR with known Dravet Syndrome
    - If the above are unavailable, consider phenobarbital 20 mg/kg/dose IV (max dose: 1,000 mg/dose)
- A second-line medication should be administered even if the seizure stops after the second dose of benzodiazepine

- Patients with established seizures:
    - Consider loading dose of home medication if IV formulation is available, OR initiate second-line medication (see above)
        - Consider a smaller loading dose for patients with established seizures on phenytoin, lacosamide, and/or VPA
            - fosphenytoin 10 mg/kg/dose IV (max dose: 1,500 mg/dose)
            - lacosamide 5 mg/kg/dose IV (max dose: 400 mg/dose)
            - VPA 20 mg/kg/dose IV (max dose: 3,000 mg/dose)

If the patient has received 2 second-line medications, continue to continuous infusions.

Continuous infusions:

- For persistent seizures, initiate a continuous IV infusion titrating to cessation of electrographic seizures on EEG or burst suppression
    - midazolam:
        - Bolus dose: 0.2 mg/kg/dose IV once
        - Continuous infusion: Initiate at 0.05 – 0.1 mg/kg/hour
        - Titration: Increase by 0.05 – 0.1 mg/kg/hour as needed for cessation of electrographic seizures on EEG or burst suppression to a max rate of 2 mg/kg/hour
    - pentobarbital
        - Bolus dose: 3 – 5 mg/kg/dose IV once
        - Continuous infusion: Initiate at 1 mg/kg/hour
        - Titration: Increase by 0.5 mg/kg/hour as needed for cessation of electrographic seizures on EEG or burst suppression to a max rate of 5 mg/kg/hour

Therapeutic drug monitoring (TDM):
Therapeutic ranges are typically established at the following timed blood collections after steady state (SS) concentrations have been reached (generally 5 – 7 half-lives after initiation or change in dosing).

- Trough concentration: 0 – 60 minutes before dose administration
- Peak concentration: generally, 1 – 2 hours after drug administration; however, this is highly drug dependent

<table>
<tr><th>Medication</th><th>Peak</th><th>Trough</th><th>SS</th><th>Therapeutic Range (mcg/mL)</th><th>Other Labs</th></tr>
<tr><td>phenobarbital</td><td rowspan="4">Obtain 2 hours after the loading dose</td><td rowspan="4">Obtain 1 hour before dose when at SS</td><td>3 – 5 weeks</td><td>15 – 40</td><td></td></tr>
<tr><td rowspan="2">fosphenytoin*</td><td rowspan="2">3 – 4 days</td><td>10 – 20 (total)</td><td>albumin</td></tr>
<tr><td>0.8 – 1.6 (free)</td><td></td></tr>
<tr><td>valproic acid</td><td>2 – 4 days</td><td>50 - 100</td><td></td></tr>
</table>

*Phenytoin correction for hypoalbuminemia: corrected phenytoin = total phenytoin level / ((0.2 x albumin) + 0.1)

Additional considerations:
The following diagnostic codes should be used in known epilepsy patients:

1. G40.311 – generalized epilepsy, intractable, with status epilepticus
2. G40.301 – generalized epilepsy, not intractable, with status epilepticus
3. G40.211 – focal epilepsy, intractable, with status epilepticus
4. G40.201 – focal epilepsy, not intractable, with status epilepticus

Additional codes that can be considered include:

1. G40.901 – status epilepticus
2. G40.821 – infantile spasms with status epilepticus
3. G40.911 – intractable epilepsy with status epilepticus
4. G40.A01 – absence epileptic syndrome, not intractable, with status epileptics

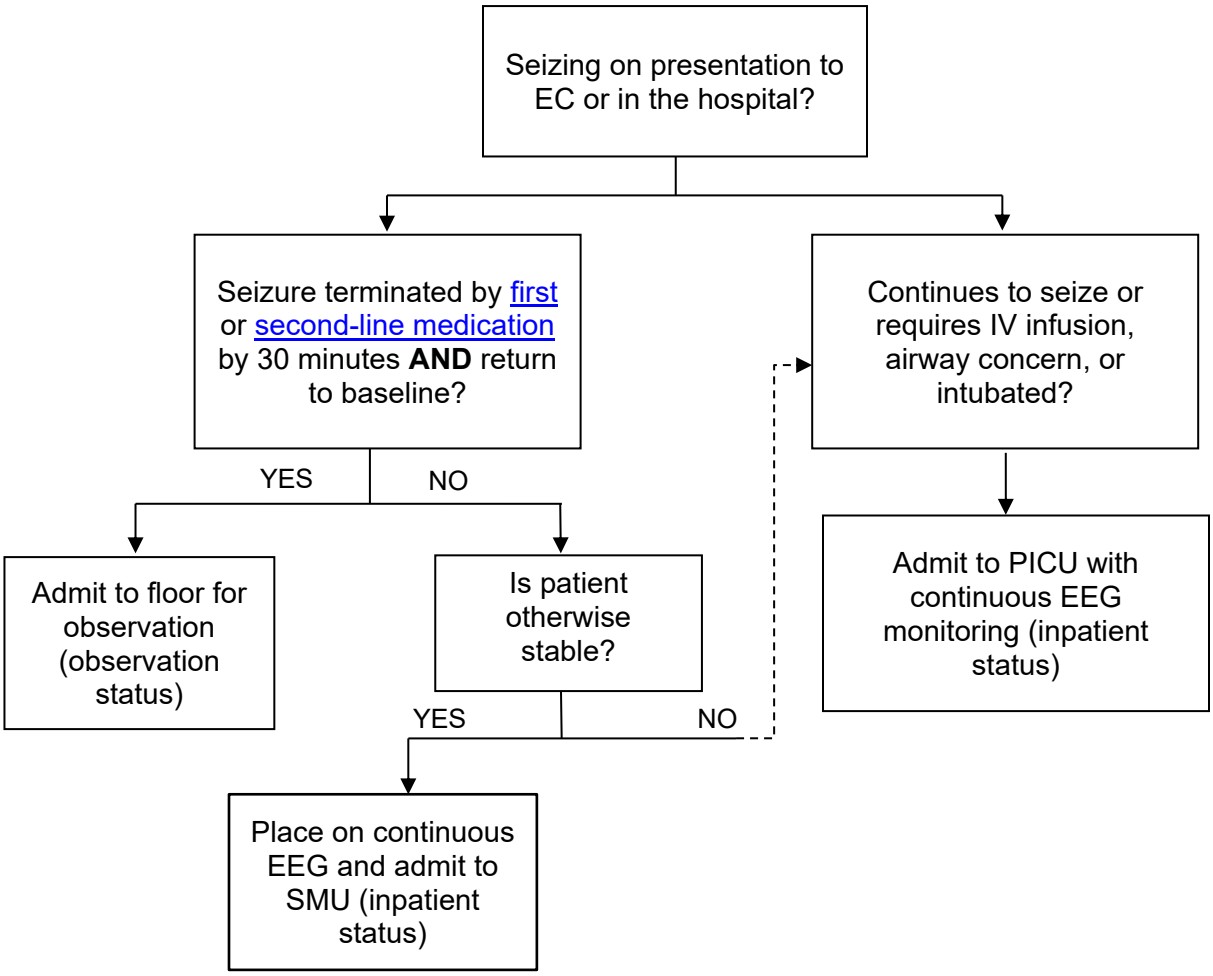
5. G40. A11 – absence epileptic syndrome, intractable, with status epilepticus
6. G40.401 – other generalized epilepsy and epileptic syndromes, not intractable, with status epilepticus
7. F44.5 – conversion disorder with seizures or convulsions

Inpatient Status and Admission / Discharge Criteria:

1. New onset seizure disorder (≥ 2 seizures in 24 hours)
   a. Intervention would require a new antiepileptic medication to be started, routine EEG or continuous EEG, neuro checks every 4 hours, and seizure precautions with anticipated stay > 24 hours
2. Known seizure disorder on antiepileptic medications with good compliance and at therapeutic level (if applicable) who has breakthrough seizures greater than 2 in 24 hours or a change in seizure type or duration:
   a. Intervention would require a change in antiepileptic medications or dose adjustments, routine or continuous EEG, neuro checks every 4 hours, and seizure precautions with anticipated stay > 24 hours
3. Patient with seizure qualifying as SE (i.e., seizure > 5 minutes and having a seizure on arrival) with anticipated stay > 24 hours
4. Patient with seizure who has not returned to baseline mental status with anticipated stay > 24 hours

Johns Hopkins All Children's Hospital

Inpatient Status Epilepticus Admission Clinical Pathway



Abbreviation: SMU, Seizure Monitoring Unit

Discharge considerations:

- No seizure activity in > 24 hours
- Patient has returned to baseline mental status
- Tolerating antiepileptic medication(s)
- Outpatient laboratory testing and Neurology follow-up appointment established

Outcome Measures:

EC/PICU:

1. Time to cessation of clinical seizures
2. Time to first-line medication
3. Time to second and third-line medication(s)
4. Time to continuous EEG placement
5. Time to continuous IV midazolam or pentobarbital infusion, if needed

Floor:

1. Time to cessation of clinical seizures
2. Time to first-line medication
3. Time to second and third-line medication(s)
4. Time to transfer to PICU

References:

1. Abend NS, Loddenkemper T. Pediatric status epilepticus management. *Curr Opin Pediatr.* 2014;26(6):668-674.

2. Chin RF, Neville BG, Peckham C, Bedford H, Wade A, Scott RC. Incidence, cause, and short-term outcome of convulsive status epilepticus in childhood: a prospective population-based study. *Lancet.* 2006;368:222-229.

3. Ng YT, Maganti R. Status epilepticus in childhood. In: Pellock JM, Bourgeois BFD, Dodson WE, eds. *Epilepsy in Children and Adolescents.* Hoboken, NJ: John Wiley & Sons; 2013.

4. Brophy GM, Bell R, Claassen J, et al. Guidelines for the evaluation and management of status epilepticus. *Neurocrit Care.* 2012;17:3-23.

5. Vasquez A, Gainza-Lein M, Sánchez Fernández I, et al. Hospital emergency treatment of convulsive status epilepticus: comparison of pathways from ten pediatric research centers. *Pediatr Neurol.* 2018;86:33-41.

6. Chin RF, Neville BG, Peckham C, et al. Treatment of community-onset childhood convulsive status epilepticus: a prospective, population-based study. *Lancet Neurol.* 2008;7(8):696-703.

7. Glauser T, Shinnar S, Gloss D, et al. Evidence-based guideline: treatment of convulsive status epilepticus in children and adults: report of the Guideline Committee of the American Epilepsy Society. *Epilepsy Curr.* 2016;16(1):48-61.

8. Lyttle MD, Rainford NE, Gamble C, et al. Levetiracetam versus phenytoin for second-line treatment of paediatric convulsive status epilepticus (EcLiPSE): a multicentre, open-label, randomized trial. *Lancet.* 2019;393:2125-2134.

9. De Paola L, et al. Improving first responders' psychogenic nonepileptic seizures diagnosis accuracy: development and validation of a 6-item bedside diagnostic tool. *Epilepsy Behav.* 2016;54:40-45.

Clinical Pathway Team

Status Epilepticus Clinical Pathway

Johns Hopkins All Children's Hospital

Owner(s): Danielle Hirsch, MD; Richard Tang-Wai, MDCM, FRCPC, FAES

Also reviewed by:

Neurology: Neel Parikh, MD

Pharmacy: Corey Fowler, PharmD, BCPPS

Educational Rollout Team: Kentlee Battick, MSN, RN, CCRN, CNL

Clinical Pathways Program Team: Courtney Titus, PA-C, Director; Kristel Lassiter, APRN, Implementation Specialist; Corey Fowler, PharmD

Approved by CPDC: November 4, 2025

Content Last Revised: December 22, 2025

Date Available on Website: December 22, 2025

Historical Submission:

Owner(s): Danielle Hirsch, MD; Jennifer Avallone, DO

Also reviewed by:

Hospital Medicine: Catherine Alexis Major, MD; Paul Evans, MD

Critical Care Medicine: Elliot Melendez, MD; Jason Parker, MD

Neurology: Thomas Geller, MD; Deborah Hill-Ray, APRN, Kelly Cuffel, APRN

Utilization Management: Paul Evans, MD

Pharmacists: Corey Fowler, PharmD, BCPPS

Educational Rollout Team: Kentlee Battick, MSN, RN, CCRN, CNL, CNRN; Jessica Marchione, MSN, RN, CCRN, NE-BC

Approved by JHACH Clinical Practice Council: May 21, 2019

Content Last Revised: December 22, 2025

Date Available on Webpage: July 7, 2019

Disclaimer:

Clinical Pathways are intended to assist physicians, physician assistants, nurse practitioners, and other healthcare providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or

conditions. The ultimate judgment regarding care of a particular patient must be made by the physician, considering the individual circumstances presented by the patient.

The information and guidelines are provided "AS IS" without warranty, express or implied, and Johns Hopkins All Children's Hospital, Inc. hereby excludes all implied warranties of merchantability and fitness for a particular use or purpose with respect to the information. Johns Hopkins All Children's Hospital, Inc. shall not be liable for direct, indirect, special, incidental, or consequential damage related to the user's decision to use the information contained herein.