Suspected BRUE
Inpatient

Nationwide Children's — When your child needs a hospital, everything matters.

Center for Clinical Excellence

Inclusion Criteria:

- Well-appearing
- Infants < 12 months old with a brief resolved event characterized by one or more of the following:
  - Color: cyanosis or pallor
  - Breathing: absent, decreased, or irregular breathing
  - Tone: marked change in tone (hyper- or hypotonia)
  - Responsiveness: altered

Exclusion Criteria:

- Age ≥ 12 mo
- Temperature > 100.4 or hypothermia
- History of any significant diagnosis, such as cardiac, neurologic, or metabolic disease
- Ongoing symptoms or ill appearing

Perform BRUE specific H&P (ADMITHP)

Review DDx

Explanation for event identified and/or patient has significant additional symptoms?

Yes →
- Document diagnosis of **BREE** (Brief Resolved **Explained** Event)
- Manage as clinically indicated

Off Pathway

No

Diagnosis of BRUE established

Monitoring
- Continuous pulse oximetry

Diagnostic Evaluation
- Diagnostic testing and consultations based on narrowed DDx and estimated risk of serious underlying condition and recurrent event using MDCalc™
- When reassuring history, exam and low estimated risk, screening tests are unlikely to contribute to an explanation[4]
- Social work evaluation with psychosocial assessment

Caregiver Education
- Provide caregiver counseling about diagnosis, risk and plan of care. Include shared decision-making whenever indicated.
- Provide caregiver CPR training

Explanation for event identified based on testing, consultations, or recurrent events?

Yes →

No

Continues to qualify as BRUE
Continuous pulse oximetry until discharge criteria met

How long to monitor a patient after a BRUE is based on the clinical judgement of the treating physician and care team, combined with shared decision making with care givers.

Meets discharge criteria?

No → Individualized management as clinically indicated. Off Pathway

Yes

Discharge home

PCP follow up within 1-3 days

Differential Diagnoses

	Potential Diagnoses	History	Physical Exam
Gastrointestinal	• GER, GERD • Laryngospasm • Overfeeding • Oropharyngeal dysphagia	• Event was around feeding time • Presence of milk or formula in nose or mouth during event • Coughing or choking with feeding • Chronic, severe, or recurrent feeding problems • Regurgitation or vomiting, irritability, feeding resistance, poor weight gain, and back arching	• Choking or gagging noises • Poor growth • Desaturations with feeds
Cardiac	• Arrhythmia: LQTS, WPW • Cardiomyopathy • Congenital heart disease	• Fatigue or diaphoresis with feeds • Recurrent cyanotic episodes • FHx: Arrhythmia (LQTS, WPW), sudden or unexplained death, SIDS, syncope	• Abnormal heart rate or rhythm • Murmur or weak pulses • Low oxygen saturation • Poor growth
Neurologic	• Seizure • Infantile spasms • CNS malformation • Elevated ICP	• Recurrent, paroxysmal or stereotypical events • Abnormal eye movements • Loss of consciousness or lethargy • Developmental delays or regressions • FHx: Infantile spasms, seizures, genetic or metabolic disorders, developmental delays	• Abnormal tone, reflexes, or neurological exam • Neurocutaneous findings • Dysmorphic features • Papilledema or bulging fontanelle • Micro- or macrocephaly
Airway and Respiratory	**Airway abnormalities** • Choanal atresia • Laryngomalacia • Tracheoesophageal fistula **Respiratory diseases:** • Central apnea (secondary to infection, CNS, CCHS, prematurity, or trauma) • Obstructive apnea (secondary to airway abnormality or poor tone) • Mixed apnea • Foreign body • Respiratory tract infection • Breath-holding spells • Periodic breathing	• Multiple or recurrent events • Respiratory pattern abnormalities (e.g., apnea or periodic breathing) • Work of breathing • Noisy breathing or snoring • Aspiration event	• Micrognathia • Poor tone • Tachypnea or periodic breathing • Stridor, or abnormal breath sounds • Focality on respiratory exam
Infectious	• Viral URTI/LRTI (e.g., RSV) • Pertussis • Bacterial pneumonia • Bacteremia, meningitis, UTI	• Additional episodes of gagging, gasping, color change with respiratory pause • Fever, respiratory or URTI symptoms • Poor oral intake or urine output • Foul-smelling urine or known CAKUT • Lethargy • Delivery complicated by prematurity, maternal GBS, PROM, maternal chorioamnionitis • Sick contacts • Under-immunized community • Previous bacterial infection	• Fever, tachycardia or tachypnea • Periods of apnea • Coryza • Irritability, lethargy or ill appearance • Poor perfusion
Metabolic	• Electrolyte abnormalities (e.g., hypocalcemia or hypoglycemia) • Inborn Errors of Metabolism	• Recurrent events or associated with stress/fasting • Failure to thrive or feeding difficulties • Abnormalities on newborn screening • Developmental delay • Severe/frequent illnesses • Prematurity, gestational diabetes, SGA/ LGA, maternal medications (e.g., betablockers or insulin) • FHx: SIDS, metabolic/genetic condition, consanguinity	• Tachycardia or tachypnea • Jittery • Abnormal level of consciousness • Dysmorphic features • Microcephaly or poor growth • Hepatosplenomegaly
Child Maltreatment	• Non-accidental head trauma • Smothering or suffocation • Poisoning or accidental ingestion • Factitious syndrome by proxy	• Inconsistent history of the event • Event incompatible with developmental age • Delay in seeking medical attention • Prior CPS involvement • Significant family stressors • Domestic violence, substance abuse, history of mental illness	• Unexplained bruising • Torn frenulum or oral bleeding/trauma • Scleral or subconjunctival hemorrhage • Macrocephaly or enlarging head circumference • Anormal neurological exam

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(Merritt et al. 2019; Nama et al. 2024; Westphal et al. 2022)

BRUE H&P

H&P (in ADMITHP note template)

- The broad objective of the BRUE History & Physical Examination (H&P) is to characterize the event, assess the risk of recurrence, and determine the presence of an underlying disorder.
- The history should be taken (in person or by phone) from persons who observed the infant during or immediately after the event and be documented using the Epic BRUE H&P template.
- A BRUE diagnosis should only be made when patient is meeting inclusion criteria, does not have any exclusion criteria and there is no explanation for the qualifying event.

Key H&P components to identify an explanation for the event include

- **HPI: Description of event**
  - What alerted the caregiver to a problem?
  - Was the infant awake or asleep?
  - What position were they in (ie. supine, prone, upright, moving)?
  - General description of the event:
    - Were they responsive during the event (ie. respond to voice)?
    - Was muscle tone increased or decreased? Were there repetitive movements?
    - Were they breathing? If so, were they struggling or did they have an irregular breathing pattern? Was there a choking or gagging noise?
    - Was the skin normal, pale, red, or blue?
    - Were the lips normal, pale, or blue?
  - What was the approximate duration of the event based on witness or clinician's best estimate?
  - How did it stop: (ie. with no intervention, picking up, patting back, mouth-to-mouth, chest compressions, etc)? Did it end abruptly or gradually?
  - How long did it take for them to get back to normal? Have they been dazed, fussy, etc. since then?

- **HPI: Circumstances and environment prior to event**
  - Recent history of illness or trauma
  - Timing of most recent feeding
  - Sleep position-prone / supine / side and sleeping arrangement, chair, lounge, crib, car seat, bed as well type of bedding and clothing.
  - Environmental exposures: Exposure to tobacco smoke, toxic substances, drugs, or sick contacts

- **PMH, including**
  - Pre-/perinatal history
  - Growth/development
  - Newborn screen results
  - Previous ER visits or hospitalizations
  - Description of similar prior episodes
  - Previous reflux and/or breathing problems (if yes, obtain details including management)

- **Medications:** including herbs, supplements, home remedies of both the infant and breastfeeding mother

- **Family history, including**
  - SIDS
  - Unexplained car accident or drowning in first-or second degree family members before age 35, and particularly as an infant
  - BRUE in sibling
  - Long QT syndrome or arrhythmia
  - Inborn error of metabolism or genetic disease
  - Developmental delay

- **Physical Exam**
  - Perform a thorough exam of undressed patient, focusing on skin (bruising or petechiae), HEENT (intact frenula, anatomic abnormalities), heart and nervous system to verify that patient is asymptomatic with negative PE findings.

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Diagnostic Evaluation

	Potential Diagnoses	Evaluation to Consider
Gastrointestinal	• GER, GERD • Laryngospasm • Overfeeding • Oropharyngeal dysphagia	• Bedside evaluation by a feeding specialist • Consider VFSS • Consider gastroenterology consultation
Cardiac	• Arrhythmia: LQTS, WPW • Cardiomyopathy • Congenital heart disease	• ECG and cardiology consult • Consider an echocardiogram
Neurologic	• Seizure • Infantile spasms • CNS malformation • Elevated ICP	• Neurology consultation • Consider EEG • Consider head imaging
Airway and Respiratory	**Airway abnormalities** • Choanal atresia • Laryngomalacia • Tracheoesophageal fistula **Respiratory diseases:** • Central apnea (secondary to infection, CNS, CCHS, prematurity, or trauma) • Obstructive apnea (secondary to airway abnormality or poor tone) • Mixed apnea • Foreign body • Respiratory tract infection • Breath-holding spells • Periodic breathing	• Otolaryngology and/or pulmonology consultation • Comprehensive polysomnography (if concerns regarding apnea) • Consider head imaging (if central apnea) • Consider CXR (if bacterial pneumonia)
Infectious	• Viral URTI/LRTI (e.g., RSV) • Pertussis • Bacterial pneumonia • Bacteremia, meningitis, UTI	• Viral respiratory panel (if it will affect management decisions) • Pertussis testing • Consider urinalysis and urine culture, blood culture +/- lumbar puncture
Metabolic	• Electrolyte abnormalities (e.g., hypocalcemia or hypoglycemia) • Inborn Errors of Metabolism	• Blood glucose, sodium, potassium, chloride, urea, creatinine, calcium, venous blood gas, ammonia, lactic acid • Biochemical genetics consult
Child Maltreatment	• Non-accidental head trauma • Smothering or suffocation • Poisoning or accidental ingestion • Factitious syndrome by proxy	• Consultation with child protection expert • Skeletal survey, head imaging, and retinal examination • Toxicology screen

(Merritt et al. 2019; Nama et al. 2024; Westphal et al. 2022)

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Psychosocial Assessment

A Social Work evaluation is <u>required</u> for all patients who meet diagnostic criteria for a BRUE

- A BRUE may be the presentation of child abuse so SW evaluation helps identify risk factors for abuse and provides support to caregivers
- SW evaluation can be completed in the ED prior to discharge home or as an inpatient
- A full psychosocial assessment should be performed, including but not limited to a detailed social history:
  - Family structure, individuals living in home?
  - Housing: general, mold?
  - Recent changes or stressors?
  - Support system(s)/access to needed resources?
  - Current level of concern/anxiety; how family manages adverse situations?
  - Previous child protective services or law enforcement involvement (ie. domestic violence, animal abuse)?
  - Exposure of child to adults with history of mental illness or substance abuse?

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Risk Assessment

MDCalc™

A **calculator** developed to show each infant's individualized risk of a serious underlying condition and risk of recurrent event (BRUE 2.0 Criteria). This decision support tool may aid clinicians and caregivers in the discussion on the benefit and harms of diagnostic testing or hospitalization.

How to use:
Currently there is insufficient evidence to determine risk percentage cutoffs for clinical decision making, including admission or inpatient management of BRUE. Clinical judgement, shared decision making and individualized care is appropriate until further consensus and evidence is available.

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Discharge

How long to monitor a patient after a BRUE is based on the clinical judgement of the treating physician and care team, combined with shared decision making with care givers

Discharge Criteria and Planning

- Asymptomatic, normal vital signs and no concerning PE findings.
- Diagnostic studies and consultations completed and reviewed (if obtained).
- Parents have received CPR training (or resources for training), and have no safety or follow up concerns.
- SW evaluation completed and no concerns identified *OR* concerns adequately addressed or resolved.
- PCP follow up within 3 days.

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Caregiver Education & Anticipatory Guidance
Page 1

	Facts for healthcare providers 	Suggested translation for caregivers 
Anticipatory guidance about what they can expect to happen during their hospitalization	1. The infant will be placed on continuous pulse oximetry. 2. A period of observation can be helpful if the infant has another event because it can help us characterize it further which may aid in making an explanatory diagnosis. It is estimated that 18% of infants have a repeat event while hospitalized. 3. Routine lab testing or imaging is not recommended because it is unlikely to lead to a diagnosis. Because disease prevalence is low in the BRUE population nonspecific tests are particularly prone to false-positive results and increased parental anxiety. Any evaluation performed should be targeted and based on specifics from the history or physical exam. 4. Approximately 55% of infants will not have an explanatory diagnosis identified during hospitalization and will be discharged as a BRUE. 5. Although rare, a BRUE may be the presentation of child abuse so social work is consulted during every admission to help identify risk factors for abuse and provide support to caregivers. 6. CPR teaching is provided to every caregiver in the form of a video or in-person instruction. While having a BRUE does not increase an infant's chances of experiencing cardiac arrest, we believe that all caregivers of infants should be trained in CPR. 7. Consider discharge if there have been no concerning recurrent events, no abnormal vital sign changes, CPR training is complete, and follow-up is scheduled.	*1. We will put "X" on a monitor and watch their heart rate, breathing, and oxygen levels while they are here.* *2. While your baby is under observation, we will be watching for another event. If you notice any changes in their color, breathing, tone, body movements, or responsiveness please call your nurse right away. In our experience, the majority of infants do not have another event while they are in the hospital.* *3. Most of the time we don't have to do any testing.* *4. Many caregivers are anxious to know what caused the event. We may have an answer by the time you are discharged home but over half of patients hospitalized with events like "X's" do not have an explanation at the time of discharge.* *5. Our Social worker visits with each family so you can expect them to come by today or tomorrow.* *6. We provide CPR teaching to every caregiver during their baby's hospital stay because we believe this is an important skill for any caregiver of an infant.* *7. Your baby may be ready for discharge home after a period of observation if there are no recurrent episodes, no abnormal changes in their heart rate, breathing pattern or oxygen levels, Social work has visited with you, CPR training has been provided, and a follow-up appointment with your family doctor is scheduled.* **Go To Page 2**

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Caregiver Education & Anticipatory Guidance
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	Facts for healthcare providers 	Suggested translation for caregivers 
Explanatory diagnoses	1. The most common explanations are due to normal infant immaturity and are not life threatening. Examples of these include GER (18.5%), choking or gagging (8.2%), viral respiratory infections (4.4%), and breath holding spells (4.1%). 2. Approximately 4% of infants will eventually be diagnosed with a serious underlying condition, some of which include seizures requiring anti-epileptic medications (1.15%), airway abnormality (0.64%), and head trauma (0.34%).	*1. The most common causes of BRUEs are not life-threatening. Over 95% of infants do not have a serious underlying diagnosis.*
No increased risk of mortality	1. There is no increased risk of death after a BRUE over the baseline risk in the first year of life. There is no known relationship between BRUE and SIDS.	*1. Given these events are scary, many caregivers worry that their baby's life was or will be at risk. There is no increased risk of death and no known relationship between BRUE and Sudden Infant Death Syndrome.*
Importance of follow-up	1. Approximately 45% of serious diagnoses are made AFTER discharge from the ED or hospital. Careful outpatient follow-up is advised to help identify infants with ongoing medical concerns that would indicate further evaluation and treatment.	*1. Please make a follow-up appointment with your baby's pediatrician for about 2 days after discharge from the hospital. If your baby has another event or develops new problems, contact the baby's doctor. If you are concerned the event could be life-threatening, call 911.*

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Helping Hands

- **Brief Resolved Unexplained Event (BRUE) Helping Hands**

Metrics

Quality Measures

Outcome Measures

- LOS
- Discharge diagnosis

Process Measures

- Use of IP BRUE Admission Order set
- Use of IP BRUE H&P template

Balance Measures

- 7 & 30 day return to ED after IP discharge
- Rate of labs, imaging, and consultations

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References

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6. Nama N, Tieder JS. Brief resolved explained and unexplained events. In: Chiang VW, Shah SS, eds. *Comprehensive Pediatric Hospital Medicine.* 3rd ed. 2024. In press.

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Last Revision: *April, 2024*

Next Revision Date: *April, 2027*

Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

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