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KEY ADVANCES
PRACTICE ADVANCE

Emergency Department Management of Acute Asthma Exacerbation in Adults

New July 2024

Why is this topic important? Asthma is a chronic obstructive airway disease with recurrent exacerbations. There are several areas of controversy regarding therapy for patients with asthma exacerbation, with recent studies evaluating different components of therapy.

How will this change my clinical practice? Initial treatment includes oxygen supplementation for hypoxia and administration of short-acting β2 agonists (SABAs), short-acting muscarinic antagonists (SAMAs), and systemic corticosteroids. Magnesium sulfate intravenous (IV) may be used as an adjunctive therapy in severe exacerbation. Airway management may be required; noninvasive positive airway pressure ventilation is recommended for those in respiratory distress. Endotracheal intubation does not address the underlying obstructive airway disease but is recommended in those with respiratory failure.

Synopsis Focus Points:

1. **Asthma is a chronic obstructive airway disease characterized by recurrent exacerbations ranging in severity. Diagnosis is based on history and examination.**
2. **Chest radiography or point-of-care ultrasound should be used in those with respiratory distress or those who fail to respond to standard therapies to evaluate for other conditions (e.g., pneumonia or pneumothorax).**
3. **Initial Emergency Department (ED) management includes supplemental oxygen if oxygen saturation is < 90%. Inhaled SABAs and SAMAs should be administered via nebulization or with a metered-dose inhaler (MDI) and spacer. In patients with moderate to severe exacerbation, continuous nebulization with SABAs and SAMAs for one hour is recommended.**
4. **Systemic steroids should be administered within one hour of presentation. Inhaled steroids are a component of outpatient management and may be prescribed at discharge for patients with poor asthma control.**
5. **Magnesium IV should be considered in those with severe exacerbation. Parenteral β2 agonists can be considered in patients who fail to respond to standard therapies.**

6. **Antibiotics such as azithromycin and inhaled magnesium do not improve patient outcomes during an acute asthma exacerbation.**
7. **Noninvasive positive pressure ventilation (NIPPV) can be used in those with significant respiratory distress.**
8. **Endotracheal intubation and mechanical ventilation should be reserved for those with respiratory failure.**

Background:

ED Evaluation
Initial assessment of the patient with suspected asthma exacerbation includes respiratory rate and heart rate, oxygenation, severity of dyspnea, wheezing, accessory muscle use, ability to speak, and mental status. The absence of wheezing in those with evidence of significant respiratory distress or altered mental status suggests impending respiratory failure.(1,2) The clinician should also consider mimics of asthma exacerbation, such as anaphylaxis, pneumonia, pulmonary embolism, heart failure, foreign bodies, and chronic obstructive pulmonary disease.

Chest radiograph is not necessary in all patients with asthma exacerbation, but may be helpful to evaluate for other conditions (e.g., pneumothorax or pneumonia) in those who do not respond to typical therapies.(1,2) Point-of-care ultrasound may be used in those with undifferentiated dyspnea. Routine laboratory analysis is unnecessary unless another condition is suspected (e.g., pulmonary embolism). Arterial blood gas is not recommended to evaluate for hypercarbia or acidosis. Venous blood gas is less painful and invasive and an adequate screen for hypercarbia and acidosis.(2) It may be obtained in those with severe exacerbation who do not improve with therapy. End tidal carbon dioxide monitoring has demonstrated promise in determining severity of airway obstruction and monitoring treatment response.(2)

Oxygen
In those with oxygen saturation < 90%, oxygen supplementation is recommended via nasal cannula or face mask, targeting a level between 93% and 95%.(1) Hyperoxia should be avoided.

Inhaled therapies
Inhaled SABAs (e.g., albuterol) are the first-line inhaled therapy for asthma exacerbation.(1) Levalbuterol does not demonstrate any advantages and costs more.(2) SABAs may be administered with a metered-dose inhaler (MDI) or nebulizer. There is no difference between MDI with spacer and nebulization in rates of hospital admission or ED length of stay in adult patients with mild to moderate exacerbation.(1,2) Dosing of albuterol MDI includes 4-10 puffs every 20 minutes up to four hours, followed by 4-10 puffs every one to four hours. Nebulized therapy is recommended in severe exacerbation.(3) Long-acting beta agonists are not recommended in the ED.

Nebulized therapy may be intermittent or continuous. However, continuous, compared to intermittent, SABA therapy is associated with improved pulmonary function and reduced hospitalization rates (number needed to treat [NNT] 10) in those with moderate to severe exacerbation.(3) Dosing of nebulized albuterol includes 5 mg every 20 minutes up to three doses or 10-20 mg continuous followed by 2.5-10 mg every one to four hours.

Inhaled SAMAs (e.g., ipratropium bromide) should be administered in those with acute asthma exacerbation, as they reduce the need for hospitalization (NNT 11).(4,5) Ipratropium MDI dosing includes eight puffs every 20 minutes as needed. Nebulized therapy includes 0.5 mg every 20 minutes

for three doses, or 1-2 mg over the first hour. This should be combined with the SABA in those with moderate to severe exacerbation, as the combination reduces the need for hospitalization (NNT 16) and risk of relapse (NNT 20) compared to using either agent alone.(6)

Steroids
Systemic steroids should be administered within one hour of presentation to the ED. Current evidence suggests that the intravenous (IV) and oral routes have equivalent bioavailability and efficacy in the majority of exacerbations.(1,2) If possible, oral administration is recommended (prednisone 40-50 mg or dexamethasone 12-16 mg), although IV administration is typically necessary in severe exacerbation (methylprednisolone one mg/kg IV or dexamethasone 12-16 mg IV). Early steroid administration reduces the need for hospitalization in those with severe exacerbation (NNT 8) and can prevent relapse (NNT 10).(7) Patients who are discharged should be prescribed oral steroids after their ED visit. A five-day regimen of prednisone (40-50 mg daily) or equivalent (dexamethasone 12-16 mg on day one and day three) may be used.(1,2)

Inhaled steroids are an integral component of the outpatient management of chronic asthma and should be considered upon discharge for use as a controller medication.(1) The combination of inhaled steroid with an inhaled β2 agonist (budesonide 200 micrograms plus formoterol 6 micrograms) is associated with reduced exacerbations, hospital admission, and need for unscheduled healthcare visit.(8)

Magnesium
Magnesium as an adjunctive therapy has been controversial. However, data suggest magnesium sulfate IV may reduce hospital admissions compared to placebo in those with severe exacerbation, as an adjunct to other therapies, or in those who do not improve with standard therapies (NNT 14).(9,10) Thus, it should be considered in those with severe exacerbations. Dosing includes 2 g IV over 20 minutes. A clear improvement in patient outcomes has not been demonstrated with the use of Inhaled magnesium sulfate.(10,11)

Parenteral Beta Agonists
Parenteral beta agonists (e.g., epinephrine and terbutaline) are potent bronchodilators. However, there are no high-quality prospective data supporting their use in severe exacerbation.(1,2,12) Epinephrine is not recommended for routine use as a first-line therapy but should be considered in doses of 0.3-0.5 mg intramuscular (IM) every 20 minutes for three doses in those with severe exacerbation who fail other therapies.(1,2) The intramuscular (IM) route in the anterolateral thigh is recommended over the subcutaneous route for epinephrine, as patients with cardiorespiratory distress and fatigue have reduced skin and subcutaneous circulation. If patients with severe hypotension or refractory to IM administration, epinephrine IV 5-20 micrograms every two to five minutes should be considered.(2)

Terbutaline is a β2 agonist. It may be administered via inhalation or the subcutaneous or IV route. However, literature does not demonstrate improved patient outcomes when terbutaline is compared to standard inhaled SABAs.(12)

Ketamine
Ketamine is a dissociative analgesic that can be considered in patients refractory to other treatments. It may reduce bronchoconstriction and airway hyperreactivity while improving pulmonary function. However, literature is controversial regarding improvement in patient outcomes.(2)

Antibiotics
Data do not suggest antibiotics improve patient outcomes or reduce symptoms compared to placebo.(13) Antibiotics should be reserved for those with evidence of bacterial pneumonia or other

infection (i.e., systemic symptoms, including fever, or consolidation on chest x-ray) and are not recommended for those with asthma exacerbation.

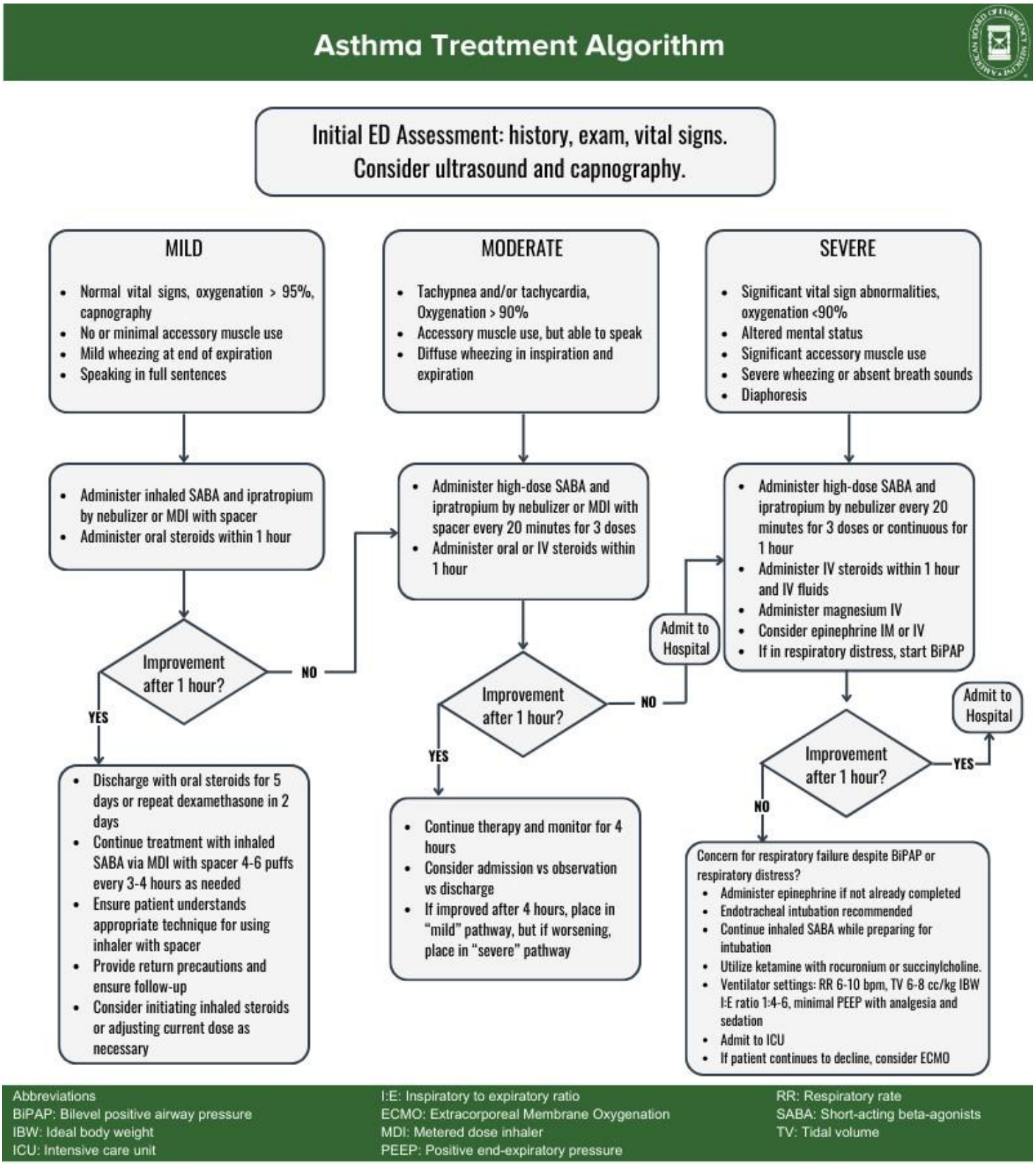
Airway support
There are limited prospective data demonstrating benefit with noninvasive positive pressure ventilation (NIPPV), although a large retrospective study of patients admitted to the critical care setting found NIPPV reduced intubation and mortality.(14) NIPPV should be considered in those with severe respiratory distress who do not respond to other therapies, as NIPPV can improve ventilation and reduce the work of breathing, and there is little harm. Bilevel positive airway pressure as opposed to continuous positive airway pressure is recommended in obstructive lung disease to improve ventilation.(2) Close monitoring of the patient is necessary to ensure improvement.

Intubation and mechanical ventilation
Intubation and mechanical ventilation should be avoided if possible, but are necessary for those with respiratory failure. Patients requiring intubation have a mortality rate up to 20% due to a variety of complications (e.g., aspiration, hyperinflation with barotrauma, and cardiorespiratory compromise).(2) Incomplete exhalation may result in breath-stacking. A plateau pressure < 30 cm H_2O is recommended, with initial ventilator settings using reduced respiratory rates (e.g., 6-10 breaths per minute) and tidal volumes (6-8 cc/kg ideal body weight) with volume cycled assist-control ventilation. An inspiratory to expiratory ratio of from 1:4 to 1:6 is recommended. Positive end-expiratory pressure (PEEP) should be minimal (0-5 cm H_2O). Adequate sedation and analgesia are necessary.(2) Ketamine should be used for induction and sedation if possible. These recommendations are based primarily on expert consensus and not prospective data.

Extracorporeal membrane oxygenation
Extracorporeal membrane oxygenation (ECMO) is a last-line modality in treatment-refractory patients and should be considered in mechanically ventilated patients with hypoxic respiratory failure or persistent hypercapnea with acidosis, in conjunction with a specialist.(2)

Disposition
Disposition should be based on treatment response, clinical course, and ability to follow-up. Patients who improve, are not in respiratory distress, and have follow-up can be discharged with oral steroids, along with SABA MDI with spacer (four puffs every three to four hours).(2) Inhaled steroids should be considered as a daily therapy for patients with asthma, which is associated with greater symptom control and reduced asthma exacerbations, ED visits, and need for hospitalization.(1) Patients with continued symptoms or cardiorespiratory distress should be admitted. Asthma care plans can improve outcomes and medication adherence, while reducing exacerbation recurrence.(1)

Figure 1. Asthma Treatment Pathway



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14. Althoff MD, Holguin F, Yang F, et al. Noninvasive ventilation use in critically ill patients with acute asthma exacerbations. *Am J Respir Crit Care Med.* 2020;202(11):1520-1530.

Notes: Practice Advance synopses should be built from a strong body of evidence, that likely includes a systematic review. The synopsis will include a recommendation that should be similar in wording to how GRADE recommendations are given. These should not be controversial recommendations and essentially all emergency physicians should be adopting them. The impact or “effect size” should be substantial and no significant harm should be associated with this gain.

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KEY ADVANCES
CLINICAL POLICY ALERT

Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department with Acute Headache

Reconfirmed May 2024

American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Acute Headache: Godwin SA, Cherkas DS, Panagos PD, Shih RD, Byyny R, Wolf SJ. Ann Emerg Med. 2019 Oct;74(4):e41-e74. doi:10.1016/j.annemergmed.2019.07.009. PMID: 31543134 (1)

Policy Recommendations and Focus Points in bold

1. In the adult emergency department (ED) patient presenting with acute nontraumatic headache, are there risk-stratification strategies that reliably identify the need for emergent neuroimaging?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (see below)
   Use the Ottawa Subarachnoid Hemorrhage Rule (age ≥ 40 years, neck pain or stiffness, witnessed loss of consciousness, onset with exertion, thunderclap headache, and limited neck flexion on examination) as a decision rule that has high sensitivity to rule out subarachnoid hemorrhage (SAH), but low specificity to rule in SAH, for patients presenting to the ED with a normal neurologic examination and peak headache severity within 1 hour of onset of pain symptoms. (2) The presence of any one criteria requires emergent neuroimaging. Although the presence of neck pain and stiffness on physical examination in ED patients with an acute headache is strongly associated with SAH, do not use a single physical sign or symptom to rule out SAH.
   Level C recommendations (none specified)

2. In the adult ED patient treated for acute primary headache, are nonopioids preferred to opioid medications?

   Patient Management Recommendations:

   Level A recommendations (see below)
   Preferentially use nonopioid medications in the treatment of acute primary headaches in ED patients.
   Level B recommendations (none specified)
   Level C recommendations (none specified)

3. In the adult ED patient presenting with acute nontraumatic headache, does a normal noncontrast head computed tomography (CT) scan performed within 6 hours of headache onset preclude the need for further diagnostic workup for SAH, including a lumbar puncture?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (see below)
   A normal noncontrast head CT (minimum third-generation scanner) performed within 6 hours of symptom onset in an ED patient with headache and a normal neurologic examination may be used to rule out nontraumatic SAH.
   Level C recommendations (none specified)

4. In the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT, is CT angiography of the head as effective as lumbar puncture to safely rule out SAH?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   Perform lumbar puncture or CT angiography to safely rule out SAH in the adult ED patient who is still considered to be at risk for SAH after a negative noncontrast head CT result.

References:

1. American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Acute Headache; Godwin SA, Cherkas DS, Panagos PD, Shih RD, Byyny R, Wolf SJ. Ann Emerg Med. 2019 Oct;74(4):e41-e74. doi:10.1016/j.annemergmed.2019.07.009. PMID: 31543134
   https://www.acep.org/patient-care/clinical-policies/headache/

2. https://emottawablog.com/2017/11/validation-ottawa-sah-rule/

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Clinical findings and strength of recommendations regarding patient management were made according to the following criteria:

Level A recommendations

Generally accepted principles for patient care that reflect a high degree of clinical certainty (e.g., based on evidence from one or more Class of Evidence I or multiple Class of Evidence II studies).

Level B recommendations

Recommendations for patient care that may identify a particular strategy or range of strategies that reflect moderate clinical certainty (e.g., based on evidence from one or more Class of Evidence II studies or strong consensus of Class of Evidence III studies).

Level C recommendations

Recommendations for patient care that are based on evidence from Class of Evidence III studies or, in the absence of adequate published literature, based on expert consensus. In instances in which consensus recommendations are made, "consensus" is placed in parentheses at the end of the recommendation.

Resources for additional learning:

https://pubmed.ncbi.nlm.nih.gov/?term=emergency+department+acute+headache

https://rebelem.com/sensitivity-of-early-brain-ct-to-exclude-aneurysmal-subarachnoid-hemorrhage/

http://www.emdocs.net/?s=headache

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KEY ADVANCES
CLINICAL POLICY ALERT

Critical Issues in the Management of Adult Patients Presenting to the Emergency Department with Community-Acquired Pneumonia

Reconfirmed May 2024

Approved by the ACEP Board of Directors, October 23, 2020. From the American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Community-Acquired Pneumonia: Michael D. Smith, MD, MBA (Subcommittee Chair); Christopher Fee, MD; Sharon E. Mace, MD; Brandon Maughan, MD, MHS, MSHP; John C. Perkins Jr, MD; Amy Kaji, MD, MPH, PhD (Methodologist); Stephen J. Wolf, MD (Committee Chair). Ann Emerg Med. 2021 Jan;77(1):e1-e57. doi:10.1016/j.annemergmed.2020.10.024. PMID: 33349374 (1)

Note from the Editors

This ACEP Clinical Policy was published prior to the COVID-19 pandemic. Although COVID-19 may lead to severe acute respiratory syndrome, clinicians must still consider the importance of additional potential causes of community-acquired pneumonia (CAP). We currently support the use of this Clinical Policy in patients with CAP without confirmed COVID-19. Patients with confirmed or suspected COVID-19–related pneumonia will require additional specific management outside the scope of this Clinical Policy.

Policy Recommendations and Focus Points in bold

1. In the adult emergency department (ED) patient diagnosed with community-acquired pneumonia, what clinical decision aids can inform the determination of patient disposition?

   Patient Management Recommendations:

   Level A recommendations (none specified)

Level B recommendations (see below)

- **The Pneumonia Severity Index (PSI) and CURB-65 decision aids can support clinical judgment by identifying patients at low risk of mortality who may be appropriate for outpatient treatment. Although both decision aids are acceptable, the PSI is supported by a larger body of evidence and is preferred by other society guidelines (**American Thoracic Society and Infectious Diseases Society of America **[ATS/IDSA] 2019 guidelines). (2-4)**

Level C recommendations (see below)

- **Among patients not receiving vasopressors or mechanical ventilation, use the 2007 IDSA/ATS Minor Criteria (Figure 1) rather than mortality prediction aids, such as the PSI or CURB-65, to help establish which patients are most appropriate for care based in an ICU setting (consensus recommendation). (5)**
- **Do not routinely use biomarkers to augment the performance of clinical decision aids to guide the disposition of ED patients with community-acquired pneumonia (consensus recommendation).**
- **Use community-acquired pneumonia clinical decision aids in conjunction with physician clinical judgment in the context of each patient's circumstances when making disposition decisions (consensus recommendation).**

2. In the adult ED patient with community-acquired pneumonia, what biomarkers can be used to direct initial antimicrobial therapy?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)

   - **Do not rely upon any current laboratory test(s), such as procalcitonin and/or C-reactive protein, to distinguish a viral pathogen from a bacterial pathogen when deciding on administration of antimicrobials in ED patients who have community-acquired pneumonia.**

3. In the adult ED patient diagnosed with community-acquired pneumonia, does a single dose of parenteral antibiotics in the ED followed by oral treatment versus oral treatment alone improve outcomes?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)

   - **Given the lack of evidence, the decision to administer a single dose of parenteral antibiotics prior to oral therapy should be guided by patient risk profile and preferences (consensus recommendation).**

References:

1. American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Community-Acquired Pneumonia; Smith, MD, Fee C, Mace SE, Maughan B, Perkins JC Jr, Kaji A, et al. Critical issues in the management of adult patients presenting to the emergency department with community-acquired pneumonia. Ann Emerg Med 2021 Jan;77(1):e1-e57. doi:10.1016/j.annemergmed. 2020.10.024. PMID: 33349374

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6. https://www.mdcalc.com/psi-port-score-pneumonia-severity-index-cap
7. https://www.mdcalc.com/curb-65-score-pneumonia-severity

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Level B recommendations

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Level C recommendations

Recommendations for patient care that are based on evidence from Class of Evidence III studies or, in the absence of adequate published literature, based on expert consensus. In instances in which consensus recommendations are made, "consensus" is placed in parentheses at the end of the recommendation.

Resources for Additional Learning:

- https://pubmed.ncbi.nlm.nih.gov/?term=community+acquired+pneumonia+emergency+department
- http://www.emdocs.net/community-acquired-pneumonia-ats-idsa-guidelines-update/
- https://emergencymedicinecases.com/community-acquired-pneumonia/

Severe community-acquired pneumonia, requiring ICU admission, is defined by either **one major** criterion or **≥ 3 minor** criteria

Table 1. 2007 Infectious Diseases Society of America/American Thoracic Society Criteria for Defining Severe Community-acquired Pneumonia
Validated definition includes either one major criterion or three or more minor criteria
Minor criteria
Respiratory rate ≥ 30 breaths/min
Pa_{O2}/F_{IO2} ratio ≤ 250
Multilobar infiltrates
Confusion/disorientation
Uremia (blood urea nitrogen level ≥ 20 mg/dl)
Leukopenia* (white blood cell count < 4,000 cells/μl)
Thrombocytopenia (platelet count < 100,000/μl)
Hypothermia (core temperature < 36°C)
Hypotension requiring aggressive fluid resuscitation
Major criteria
Septic shock with need for vasopressors
Respiratory failure requiring mechanical ventilation
*Due to infection alone (i.e., not chemotherapy induced).

Figure 1. (5)

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KEY ADVANCES
CLINICAL POLICY ALERT

Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department with Seizures

Reconfirmed May 2024

Huff JS, Melnick ER, Tomaszewski CA, Thiessen ME, Jagoda AS, Fesmire FM; American College of Emergency Physicians. Clinical policy: critical issues in the evaluation and management of adult patients presenting to the emergency department with seizures. Ann Emerg Med. 2014;63(4):437-447.e15. doi:10.1016/j.annemergmed.2014.01.018. PMID: 24655445

Policy Recommendations and Focus Points in bold

1. In patients with a first generalized convulsive seizure who have returned to their baseline clinical status, should antiepileptic therapy be initiated in the emergency department (ED) to prevent additional seizures?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)

   Emergency physicians need not initiate antiepileptic medication in the ED for patients who have had a first provoked seizure. Precipitating medical conditions should be identified and treated.

   Emergency physicians need not initiate antiepileptic medication in the ED for patients who have had a first unprovoked seizure without evidence of brain disease or injury.

   Emergency physicians may initiate antiepileptic medication in the ED, or defer in coordination with other providers, for patients who experienced a first unprovoked seizure with a remote history of brain disease or injury.

2. In patients with a first unprovoked seizure who have returned to their baseline clinical status in the ED, should the patient be admitted to the hospital to prevent adverse events?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   Emergency physicians need not admit patients with a first unprovoked seizure who have returned to their clinical baseline in the ED.

3. In patients with a known seizure disorder in which resuming their antiepileptic medication in the ED is deemed appropriate, does the route of administration impact recurrence of seizures?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   When resuming antiepileptic medication in the ED is deemed appropriate, emergency physicians may administer intravenous (IV) or oral medication at their discretion.

4. In ED patients with generalized convulsive status epilepticus who continue to have seizures despite receiving optimal dosing of a benzodiazepine, which agent or agents should be administered next to terminate seizures?

   Patient Management Recommendations:

   Level A recommendations (see below)
   Emergency physicians should administer an additional antiepileptic medication in ED patients with refractory status epilepticus who have failed treatment with benzodiazepines.
   Level B recommendations (see below)
   Emergency physicians may administer IV phenytoin, fosphenytoin, levetiracetam,* or valproate in ED patients with refractory status epilepticus who have failed treatment with benzodiazepines.
   Level C recommendations (see below)
   ***Emergency physicians may administer IV propofol, or barbiturates in ED patients with refractory status epilepticus who have failed treatment with benzodiazepines.**

References:

1. https://www.acep.org/patient-care/clinical-policies/seizure/

2. *Kapur J, Elm J, Chamberlain JM, Barsan W, Cloyd J, Lowenstein D, Shinnar S, Conwit R, Meinzer C, Cock H, Fountain N, Connor JT, Silbergleit R; NETT and PECARN Investigators. Randomized Trial of Three Anticonvulsant Medications for Status Epilepticus. *N Engl J Med.* 2019;381(22):2103-2113. doi:10.1056/NEJMoa1905795. PMID: 31774955; PMCID: PMC7098487.

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Clinical findings and strength of recommendations regarding patient management were made according to the following criteria:

Level A recommendations

Generally accepted principles for patient care that reflect a high degree of clinical certainty (e.g., based on evidence from one or more Class of Evidence I or multiple Class of Evidence II studies).

Level B recommendations

Recommendations for patient care that may identify a particular strategy or range of strategies that reflect moderate clinical certainty (e.g., based on evidence from one or more Class of Evidence II studies or strong consensus of Class of Evidence III studies).

Level C recommendations

Recommendations for patient care that are based on evidence from Class of Evidence III studies or, in the absence of adequate published literature, based on expert consensus. In instances in which consensus recommendations are made, "consensus" is placed in parentheses at the end of the recommendation.

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KEY ADVANCES
CLINICAL POLICY ALERT

American Heart Association Focused Updates for ACLS from 2018, 2019, 2020, and 2023

Updated May 2024

2018 American Heart Association Focused Update on Advanced Cardiovascular Life Support Use of Antiarrhythmic Drugs During and Immediately After Cardiac Arrest: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (1)

2019 American Heart Association Focused Update on Advanced Cardiovascular Life Support Use of Advanced Airways, Vasopressors, and Extracorporeal Cardiopulmonary Resuscitation During Cardiac Arrest: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (2)

Adult Basic and Advanced Life Support Writing Group. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (3)

2023 American Heart Association Focused Update on Adult Advanced Cardiovascular Life Support: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (4)

2023 American Heart Association Focused Update on the Management of Patients With Cardiac Arrest or Life-Threatening Toxicity Due to Poisoning: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (5)

Policy Recommendations and Focus Points in bold

2018 Recommendations for Use of Antiarrhythmic Drugs During Resuscitation From Adult Ventricular Fibrillation/Pulseless Ventricular Tachycardia (VF/pVT) Cardiac Arrest

Patient Management Recommendations:

Amiodarone and Lidocaine Recommendation—Updated

- **Amiodarone or lidocaine may be considered for VF/pVT that is unresponsive to defibrillation. These drugs may be particularly useful for patients with witnessed arrest, for whom time to drug administration may be shorter (Class IIb; Level of Evidence B-R).**

Magnesium Recommendation—Updated 2018

- **The routine use of magnesium for cardiac arrest is not recommended in adult patients (Class III: No Benefit; Level of Evidence C-LD). Magnesium may be considered for torsades de pointes (i.e., polymorphic VT associated with long-QT interval) (Class Iib; Level of Evidence C-LD). The wording of this recommendation is consistent with the American Heart Association's 2010 Advanced Cardiovascular Life Support (ACLS) guidelines.**

2018 Recommendations for Antiarrhythmic Drugs Immediately After Return of Spontaneous Circulation (ROSC) Following Cardiac Arrest

β-Blocker Recommendation—Updated 2018

- **There is insufficient evidence to support or refute the routine use of a β-blocker early (within the first hour) after ROSC.**

Lidocaine Recommendations—Updated 2018

- **There is insufficient evidence to support or refute the routine use of lidocaine early (within the first hour) after ROSC.**

- **In the absence of contraindications, the prophylactic use of lidocaine may be considered in specific circumstances (such as during emergency medical services transport) when treatment of recurrent VF/pVT might prove to be challenging (Class Iib; Level of Evidence C-LD).**

2019 Recommendations for Use of Advanced Airways, Vasopressors, and Extracorporeal Cardiopulmonary Resuscitation (ECPR) During Cardiac Arrest

Patient Management Recommendations:

Choice of an Advanced Airway—Updated 2019

- **Either bag-mask ventilation or an advanced airway strategy may be considered during CPR for adult cardiac arrest in any setting (Class 2b; Level of Evidence B-R).**

- **If an advanced airway is used, the supraglottic airway device (SGA) can be used for adults with out-of-hospital cardiac arrest (OHCA) in settings with low tracheal intubation**

success rate or minimal training opportunities for endotracheal tube (ETT) placement (Class 2a; Level of Evidence B-R).

- **If an advanced airway is used, either the SGA or ETT can be used for adults with OHCA in settings with high tracheal intubation success rates or optimal training opportunities for ETT placement (Class 2a; Level of Evidence B-R).**

- **If an advanced airway is used in the in-hospital setting by expert providers trained in these procedures, either the SGA or ETT can be used (Class 2a; Level of Evidence B-R).**

- **Frequent experience or frequent re-training is recommended for providers who perform endotracheal intubation (Class 1; Level of Evidence B-NR).**

- **Emergency medical services systems that perform prehospital intubation should provide a program of ongoing quality improvement to minimize complications and to track overall SGA and ETT placement success rates (Class 1; Level of Evidence C-EO).**

Use of Vasopressors in Cardiac Arrest—Updated 2023

Recommendation: Standard-Dose Epinephrine—Updated 2023

- **We recommend that epinephrine be administered to patients in cardiac arrest (Class 1; Level of Evidence B-R). Based on the protocol used in clinical trials, it is reasonable to administer 1 mg every 3 to 5 minutes (Class 2a; Level of Evidence C-LD).**

Recommendation: Standard-Dose Epinephrine Versus High-Dose Epinephrine—Unchanged

- **High-dose epinephrine is not recommended for routine use in cardiac arrest (Class 3: No Benefit; Level of Evidence B-R).**

Recommendation: Vasopressin Versus Epinephrine—Updated 2023

- **Vasopressin may be considered in a cardiac arrest but offers no advantage as a substitute for epinephrine in cardiac arrest (Class 2b; Level of Evidence C-LD).**

Recommendation: Epinephrine in Combination With Vasopressin Versus Epinephrine Only — Updated 2019

- **Vasopressin in combination with epinephrine may be considered during cardiac arrest but offers no advantage as a substitute for epinephrine alone (Class 2b; Level of Evidence C-LD).**

Recommendations: Timing of Epinephrine Administration—Updated 2023

- **With respect to timing, for cardiac arrest with a nonshockable rhythm, it is reasonable to administer epinephrine as soon as feasible (Class 2a; Level of Evidence C-LD).**

- **With respect to timing, for cardiac arrest with a shockable rhythm, it may be reasonable to administer epinephrine after initial defibrillation attempts have failed (Class 2b; Level of Evidence C-LD).**

Recommendations: Extracorporeal CPR (ECPR)—Updated 2023

- **There is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest.**

- **ECPR may be considered for selected patients as rescue therapy when conventional CPR efforts are failing in settings in which it can be expeditiously implemented and supported by skilled providers (Class 2b; Level of Evidence C-LD).**

Use of Resuscitation Adjuncts—Updated 2020

Recommendation: Use of End-tidal CO_2 ($ETCO_2$) in Resuscitation

- **Continuously measuring $ETCO_2$ during ACLS resuscitation may be useful to improve CPR quality (Class 2b, LOE C-LD).**

Recommendation: Use of Double Sequential Defibrillation

- **Routine use of double sequential defibrillation is not recommended (Class 2b, LOE C-LD).**
- **Note: A recent randomized trial has demonstrated survival benefit of double sequential defibrillation for patients with refractory VF (i.e., VF persists after 3 standard shocks) (6)**

Special Considerations—Updated 2020

Recommendations: Cardiac Arrest in Pregnancy

- **Management of cardiac arrest in pregnancy focuses on maternal resuscitation, with preparation for early perimortem cesarean delivery if necessary to save the infant and improve the chances of successful resuscitation of the mother (Class 1, LOE C-LD).**

- **Fetal monitoring should not be undertaken during cardiac arrest in pregnancy because of potential interference with maternal resuscitation (Class 1, LOE C-EO).**

- **Targeted temperature management for pregnant women who remain comatose after resuscitation from cardiac arrest is recommended (Class 1, LOE C-EO).**

- **During targeted temperature management of the pregnant patient, it is recommended that the fetus be continuously monitored for bradycardia as a potential complication, and obstetric and neonatal consultation should be sought (Class 1, LOE C-EO).**

Recommendation: Resuscitation Debriefing

- **After a resuscitation, debriefing for lay rescuers, emergency medical services providers, and hospital-based healthcare workers may be beneficial to support their mental health and well-being (Class 2b, LOE C-LD).**

2023 Updates on Vasopressor Medications During Cardiac Arrest

- **It is recommended that epinephrine be administered for patients in cardiac arrest. (Class 1, LOE B-R)**
- **It is reasonable to administer epinephrine 1 mg every 3 to 5 minutes for cardiac arrest. (Class 2a, LOE B-R)**
- **It is reasonable to administer epinephrine as soon as feasible for nonshockable rhythm. (Class 2a, LOE C-LD)**
- **Vasopressin alone or in combination with methylprednisolone offers no advantage as a substitute for epinephrine. (Class 2b, LOE B-R)**
- **It may be reasonable to administer epinephrine after initial defibrillation attempts have failed for cardiac arrest with shockable rhythm. (Class 2b, LOE C-LD)**

2023 Updates on Nonvasopressor Medications During Cardiac Arrest

- **Amiodarone or lidocaine may be considered forVF/pVT that is unresponsive to defibrillation. (Class 2, LOE B-R)**
- **For patients with OHCA, use of steroids during CPR is of uncertain benefit. (Class 2b, LOE C-LD)**
- **Routine administration of calcium for treatment of cardiac arrest is not recommended. (Class 3: No Benefit, LOE B-R)**
- **Routine use of sodium bicarbonate is not recommended for patients in cardiac arrest. (Class 3: No Benefit, LOE B-R)**
- **Routine use of magnesium for cardiac arrest is not recommended. (Class 3: No Benefit, LOE B-R)**

2023 Updates on ECPR for Cardiac Arrest

- **Use of ECPR for patients with cardiac arrest refractory to standard ACLS is reasonable in select patients when provided within an appropriately trained and equipped systems of care. (Class 2a, LOE B-R)**

2023 Updates on Percutaneous Coronary Intervention After Cardiac Arrest

- **Coronary angiography should be performed emergently for all cardiac arrest patients with suspected cardiac cause of arrest and ST-segment elevation on electrocardiogram. (Class 1, LOE B-NR)**

- **Emergent coronary angiography is reasonable for selected adult patients without ST-elevation on electrocardiogram but with elevated risk of significant coronary artery disease where revascularization may provide benefit, such as those with shock, electrical instability, signs of significant ongoing myocardial damage, or ongoing ischemia. (Class 2a, LOE B-NR)**

- **Independent of a patient's neurologic status, coronary angiography is reasonable in all post-cardiac arrest patients for whom coronary angiography is otherwise indicated. (Class 2a, LOE C-LD)**

- **Emergent coronary angiography is not recommended over a delayed or selective strategy in patients with ROSC after cardiac arrest in the absence of ST-segment elevation, shock, electrical instability, signs of significant myocardial damage, and ongoing ischemia. (Class 3: No Benefit, LOE B-R)**

2023 Updates on Indications for Temperature Control

- **We recommend all adults who do not follow commands after ROSC, irrespective of arrest location or presenting rhythm, receive treatment that includes a deliberate strategy for temperature control. (Class 1, LOE B-R)**

2023 Updates on Performance of Temperature Control

- **We recommend selecting and maintaining a constant temperature between 32°C and 37.5°C during post-arrest temperature control. (Class 1, LOE B-R)**

- **We recommend hospitals develop protocols for post-arrest temperature control. (Class 1, LOE B-NR)**

2023 Updates on Diversity, Equity, and Inclusion

- **It is reasonable for researchers studying cardiac arrest to develop and implement methods to promote recruitment and representation of participants from diverse backgrounds. (Class 2a, LOE C-EO)**

2023 Focused Update on Management of Patients with Cardiac Arrest Due to Poisoning

- High-dose insulin is recommended to be administered for hypotension due to β-blocker poisoning refractory to or in conjunction with vasopressor therapy. (Class 1, LOE B-NR)

- It is recommended that vasopressors be administered for hypotension due to β-blocker poisoning. (Class 1, LOE C-LD)

- High-dose insulin is recommended to be administered for hypotension due to calcium channel blocker poisoning. (Class 1, LOE B-NR)

- It is recommended that vasopressors be administered for hypotension due to calcium channel blocker poisoning. (Class 1, LOE C-LD)

- It is recommended to use rapid external cooling for life-threatening hyperthermia from cocaine poisoning. (Class 1, LOE C-LD)

- It is recommended to administer hydroxocobalamin for cyanide poisoning. (Class 1, LOE C-LD)

- It is recommended that sodium nitrite be administered for cyanide poisoning when hydroxocobalamin is unavailable. (Class 1, LOE C-LD)

- It is recommended to administer digoxin-specific antibody fragments (digoxin-Fab) for digoxin or digitoxin poisoning. (Class 1, LOE B-NR)

- It is recommended to administer intravenous lipid emulsion for local anesthetic poisoning. (Class 1, LOE C-LD)

- It is recommended to use benzodiazepines to treat seizures associated with local anesthetic systemic toxicity. (Class 1, LOE C-LD)

- It is recommended to administer methylene blue for methemoglobinemia. (Class 1, LOE B-NR)

- For patients known or suspected to be in cardiac arrest, in the absence of a proven benefit from the use of naloxone, standard resuscitative measures should take priority over naloxone administration, with a focus on high-quality CPR (compressions plus ventilation). (Class 1, LOE C-EO)

- After return of spontaneous breathing, patients should be observed in a healthcare setting until the risk of recurrent opioid toxicity is low and the patient's level of consciousness and vital signs have normalized. (Class 1, LOE C-LD)

References:

1. Panchal AR, Berg KM, Kudenchuk PJ, Del Rios M, Hirsch KG, Link MS, Kurz MC, Chan PS, Cabañas JG, Morley PT, Hazinski MF, Donnino MW. 2018 American Heart Association focused update on advanced cardiovascular life support use of antiarrhythmic drugs during and immediately after cardiac arrest: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2018;138:e740–e749. doi:10.1161/CIR.0000000000000613.
2. Panchal AR, Berg KM, Hirsch KG, Kudenchuk PJ, Del Rios M, Cabañas JG, Link MS, Kurz MC, Chan PS, Morley PT, Hazinski MF, Donnino MW. 2019 American Heart Association

focused update on advanced cardiovascular life support use of advanced airways, vasopressors, and extracorporeal cardiopulmonary resuscitation during cardiac arrest: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2019;140:e881–e894. doi:10.1161/CIR.0000000000000732.

3. Panchal AR, Bartos JA, Cabañas JG, Donnino MW, Drennan IR, Hirsch KG, Kudenchuk PJ, Kurz MC, Lavonas EJ, Morley PT, O'Neil BJ, Peberdy MA, Rittenberger JC, Rodriguez AJ, Sawyer KN, Berg KM; Adult Basic and Advanced Life Support Writing Group. Part 3: Adult basic and advanced life support: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2020;142(16_suppl_2):S366-S468. doi:10.1161/CIR.0000000000000916. Epub 2020 Oct 21. PMID: 33081529.
4. Perman SM, Elmer J, Maciel CB, Uzendu A, May T, Mumma BE, Bartos JA, Rodriguez AJ, Kurz MC, Panchal AR, Rittenberger JC; American Heart Association. 2023 American Heart Association focused update on adult advanced cardiovascular life support: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2024;149(5):e254-e273. doi:10.1161/CIR.0000000000001194. Epub 2023 Dec 18. PMID: 38108133.
5. Lavonas EJ, Akpunonu PD, Arens AM, Babu KM, Cao D, Hoffman RS, Hoyte CO, Mazer-Amirshahi ME, Stolbach A, St-Onge M, Thompson TM, Wang GS, Hoover AV, Drennan IR; American Heart Association. 2023 American Heart Association focused update on the management of patients with cardiac arrest or life-threatening toxicity due to poisoning: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2023;148(16):e149-e184. doi:10.1161/CIR.0000000000001161. Epub 2023 Sep 18. PMID: 37721023.
6. Cheskes S, Verbeek R, Drennan IR, et al. Defibrillation strategies for refractory ventricular fibrillation. *N Engl J Med.* 2022;387:1947-1956.

Resources for additional learning:

https://pubmed.ncbi.nlm.nih.gov/?term=adult+emergency+cardiac+arrest

https://www.resuscitationacademy.org/blog/

https://rebelem.com/rebel-cast-ep77-2019-acls-update/

https://www.ahajournals.org/doi/epub/10.1161/CIR.0000000000000732

https://canadiem.org/2020-american-heart-association-guidelines-for-adult-basic-and-advanced-life-support/

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KEY ADVANCES
CLINICAL POLICY ALERT

Critical Issues Related to Opioids in Adult Patients Presenting to the Emergency Department

Reconfirmed May 2024

American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Opioids; Benjamin W. Hatten, Stephen V. Cantrill, Jeffrey S. Dubin, Eric M. Ketcham, Daniel P. Runde, Stephen P. Wall, Stephen J. Wolf

Policy Recommendations and Focus Points in bold

1. In adult patients experiencing opioid withdrawal, is emergency department (ED)-administered buprenorphine as effective for the management of opioid withdrawal compared with alternative management strategies?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (see below)
   When possible, treat opioid withdrawal in the ED with buprenorphine or methadone as a more effective option compared with nonopioid-based management strategies, such as the combination of α2-adrenergic agonists and antiemetics.
   Level C recommendations (see below)
   Preferentially treat opioid withdrawal in the ED with buprenorphine rather than methadone.

2. In adult patients experiencing an acute painful condition, do the benefits of prescribing a short course of opioids on discharge from the ED outweigh the potential harms?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   Preferentially prescribe nonopioid analgesic therapies (nonpharmacologic and pharmacologic) rather than opioids as the initial treatment of acute pain in patients discharged from the ED. For cases in which opioid medications are deemed necessary, prescribe the lowest effective dose of a short-acting opioid for the shortest time indicated.

3. In adult patients with an acute exacerbation of noncancer chronic pain, do the benefits of prescribing a short course of opioids on discharge from the ED outweigh the potential harms?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   Do not routinely prescribe opioids to treat an acute exacerbation of noncancer chronic pain for patients discharged from the ED. Nonopioid analgesic therapies (nonpharmacologic and pharmacologic) should be used preferentially. For cases in which opioid medications are deemed appropriate, prescribe the lowest indicated dose of a short-acting opioid for the shortest time that is feasible.

4. In adult patients with an acute episode of pain being discharged from the ED, do the harms of a short concomitant course of opioids and muscle relaxants/sedative-hypnotics outweigh the benefits?

   Patient Management Recommendations:

   Level A recommendations (none specified)
   Level B recommendations (none specified)
   Level C recommendations (see below)
   Do not routinely prescribe, or knowingly cause to be co-prescribed, a simultaneous course of opioids and benzodiazepines (as well as other muscle relaxants/sedative-hypnotics) for treatment of an acute episode of pain in patients discharged from the ED (consensus recommendation).

References:

1. American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Opioids; Hatten BW, Cantrill SV, Dubin JS, Ketcham EM, Runde DP, Wall SP, Wolf SJ. Clinical policy: critical issues related to opioids in adult patients presenting to the emergency department. Ann Emerg Med. 2020 Sep;76(3):e13-e39. doi:10.1016/j.annemergmed.2020.06.049
https://www.acep.org/patient-care/clinical-policies/opioids/

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Resources for additional learning:

https://pubmed.ncbi.nlm.nih.gov/?term=opioids+emergency+department+clinical+policy

https://journalfeed.org/article-a-day/2020/acep-opioid-policy-statement

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KEY ADVANCES
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Febrile Infants

Updated May 2024

Pantell RH, Roberts KB, Adams WG, Dreyer BP, Kuppermann N, O'Leary ST, Okechukwu K, Woods CR Jr; Subcommittee on Febrile Infants. Clinical practice guideline: evaluation and management of well-appearing febrile infants 8 to 60 days old. Pediatrics 2021;148(2):e2021052228. doi:10.1542/peds.2021-052228

Changing bacteriology, advances in technology, opportunities for improvement in care, and cost concerns have prompted the American Academy of Pediatrics to publish a clinical practice guideline for the **well-appearing, full-term, previously healthy**, febrile (≥38°C) infant. Evaluation is based on age, history, physical examination, and inflammatory markers (IMs) (if obtained): elevated temperature >38.5°C (older age groups); procalcitonin (PCT) >0.5 mg/mL; C-reactive protein (CRP) >20 mg/L; absolute neutrophil count (ANC) >4000 per mm^3; or ANC >5200 per mm^3 when PCT is unavailable.

All infants under 28 days

- Obtain urinalysis, urine culture, and blood culture
  Grade: A; Strong Recommendation

For infants 8-21 days (no change from standard practice)

- Perform lumbar puncture (LP) on all
  Grade: A; Strong Recommendation
- Evaluate for risk of herpes simplex virus (HSV)
  Grade: A; Strong Recommendation
- Administer appropriate parenteral antimicrobials
  Grade: A; Strong Recommendation
- Admit
  Grade: A; Strong Recommendation

For infants 22-28 days (may treat as above category)

- Obtain IMs
  Grade: B; Moderate Recommendation

- Any abnormal IM prompts LP
  Grade: C; Moderate Recommendation
- Any positive infectious source requires admission
  Grade: A; Strong Recommendation
- If LP is not successful or not attempted, admit. If IM is abnormal, give antibiotics; if negative, may hold antibiotics
  Grade: B; Weak Recommendation
- In rare cases, if all workup is negative and caregivers are amenable and able: there is an option to give intravenous antimicrobials, send home with cultures pending, and follow-up next day
  Grade: B; Moderate Recommendation

Infants 29-60 days (selective workup and treatment)

- Obtain urinalysis, urine culture, and blood culture
  Grade: B; Moderate Recommendation
- IMs guide further workup
  Grade: B; Moderate Recommendation
- Depending on laboratory results and situational factors, options vary in terms of LP, antimicrobials, and disposition

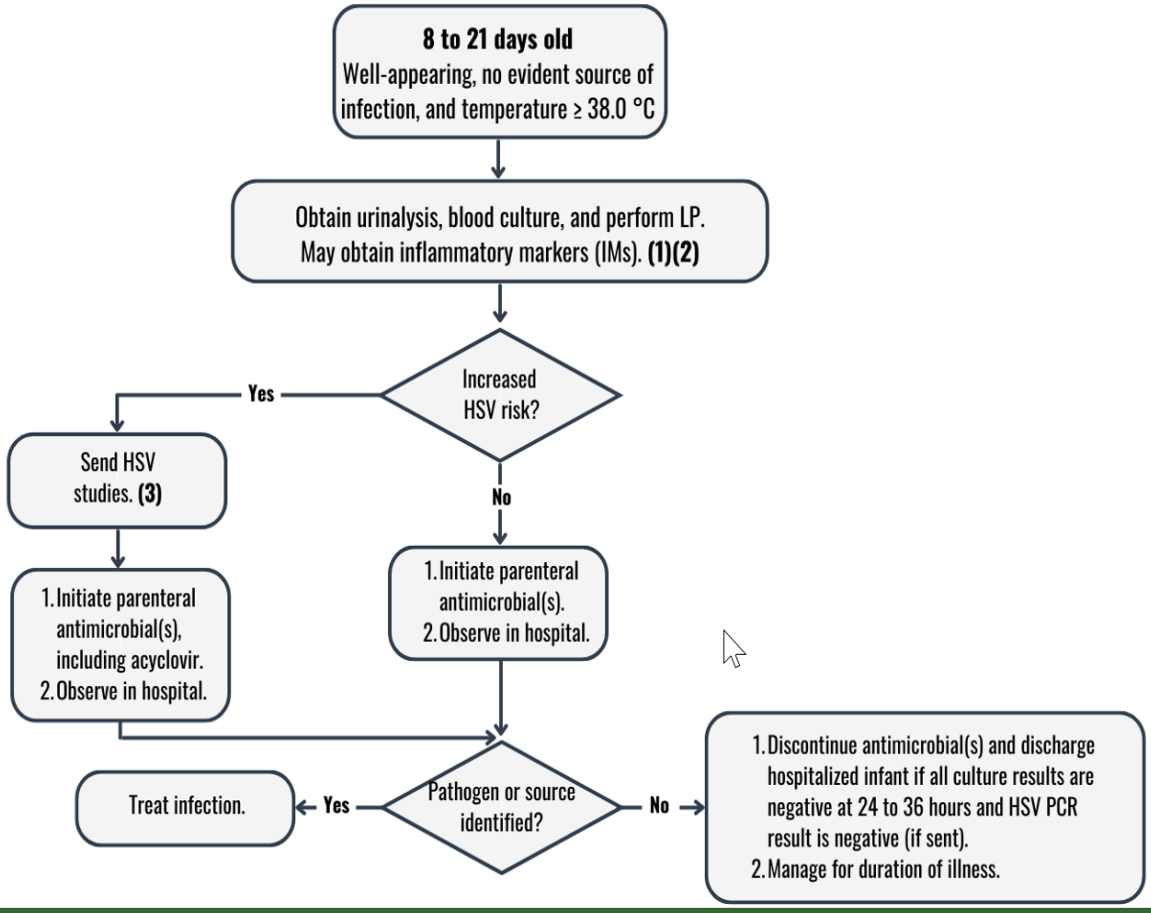
Algorithm for 8- to 21-day-old infants

(1) Laboratory values of inflammation are considered elevated at the following levels: (1) PCT >0.5 ng/mL, (2) CRP >20 mg/L, and (3) ANC >4000 per mm^3, >5200 per mm^3. Although we recommend all infants in this age group have a complete sepsis workup, receive parenteral antimicrobial agents, and be monitored in a hospital, knowing IM results can potentially guide ongoing clinical decisions.

(2) Send cerebrospinal fluid (CSF) for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus polymerase chain reaction (PCR) (if available) if pleocytosis is present and during periods of increased local enterovirus prevalence.

(3) HSV should be considered if the mother has genital HSV lesions or fever from 48 hours before to 48 hours after delivery and in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. Recommended HSV studies are CSF PCR; HSV surface swabs of the mouth, nasopharynx, conjunctivae, and anus for an HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR.

Febrile Infants Recommendation Algorithm



Adapted with permission from Robert H. Pantell, Kenneth B. Roberts, William G. Adams, Benard P. Dreyer, Nathan Kuppermann, Sean T. O'Leary, Kymika Okechukwu, Charles R. Woods Jr., SUBCOMMITTEE ON FEBRILE INFANTS; Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old. Pediatrics August 2021; 148 (2): e2021052228. 10.1542/peds.2021-052228

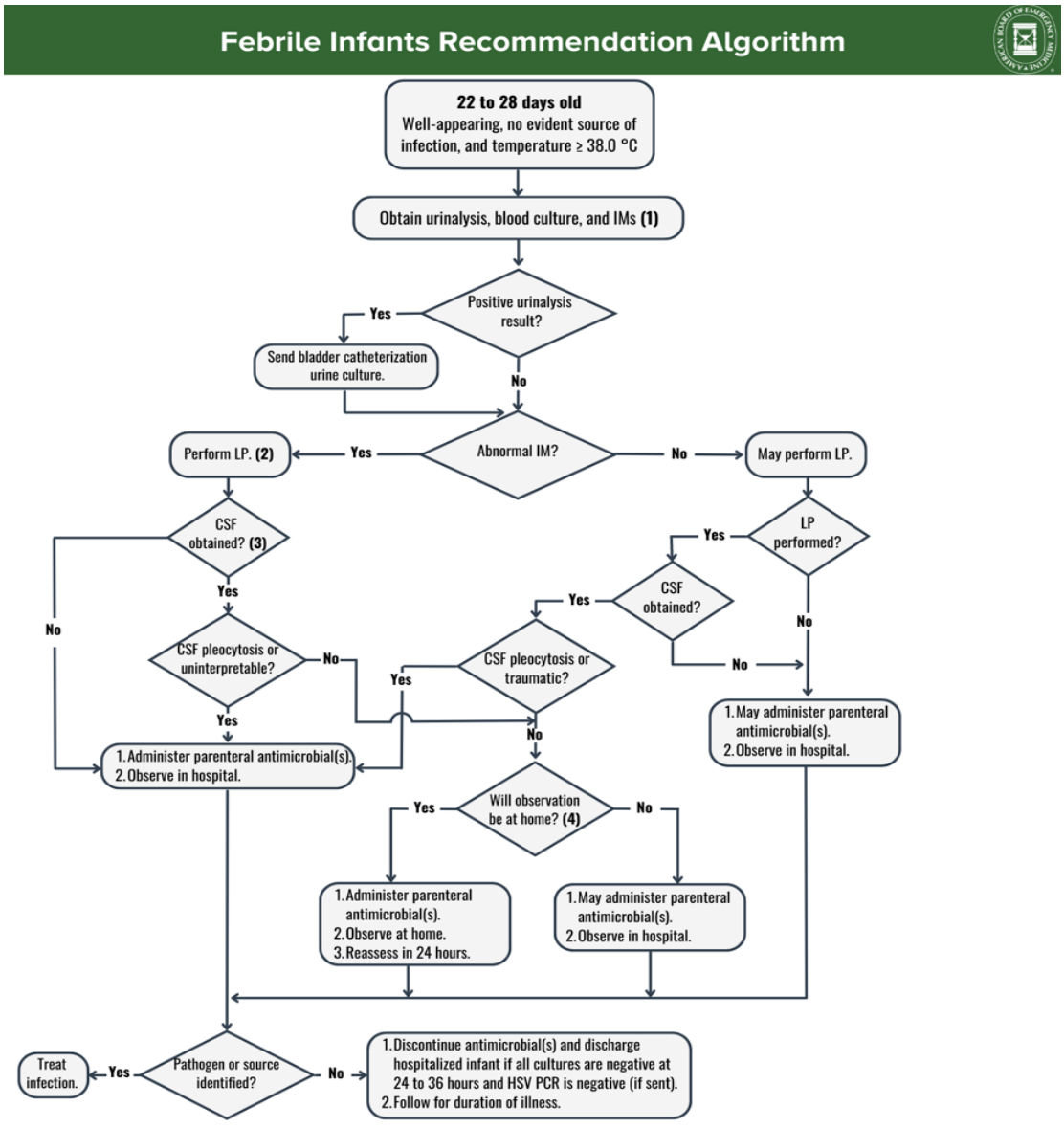
Algorithm for 22- to 28-day-old infants

(1) If available, PCT should be obtained along with ANC. If PCT is unavailable, ANC and CRP should be obtained, and a temperature >38.5°C is considered abnormal. PCT is considered abnormal at >0.5 mg/mL; CRP is considered abnormal at >20 mg/L; ANC is considered abnormal at >4000 per mm^3 when used in conjunction with PCT or >5200 per mm^3 when PCT is unavailable.

(2) LP is recommended before administration of antimicrobial agents because interpreting CSF after the administration of antimicrobial agents is difficult. However, the risk of meningitis in 22- to 28-day-old infants was lower than that in infants <22 days old in several studies. Therefore, in some circumstances, clinicians may elect to defer an LP and initiate antimicrobial agents, recognizing the potential risk of partially treated meningitis. Send CSF for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus PCR (if available) if pleocytosis is present and during periods of increased enterovirus prevalence. HSV can occur in this age group.

(3) HSV should be considered in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. Recommended HSV studies: CSF PCR; HSV surface swabs of mouth, nasopharynx, conjunctivae, and anus for HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR.

(4) Infant may be managed at home if parent and clinician agree that the following are present: reliable phone and transportation, parent willingness to observe and communicate changes in condition, and agreement to the infant being reevaluated in 24 hours. If CSF is positive for enterovirus, clinicians may withhold or discontinue antimicrobial agents and discharge at 24 hours, provided they meet other criteria for observation at home.



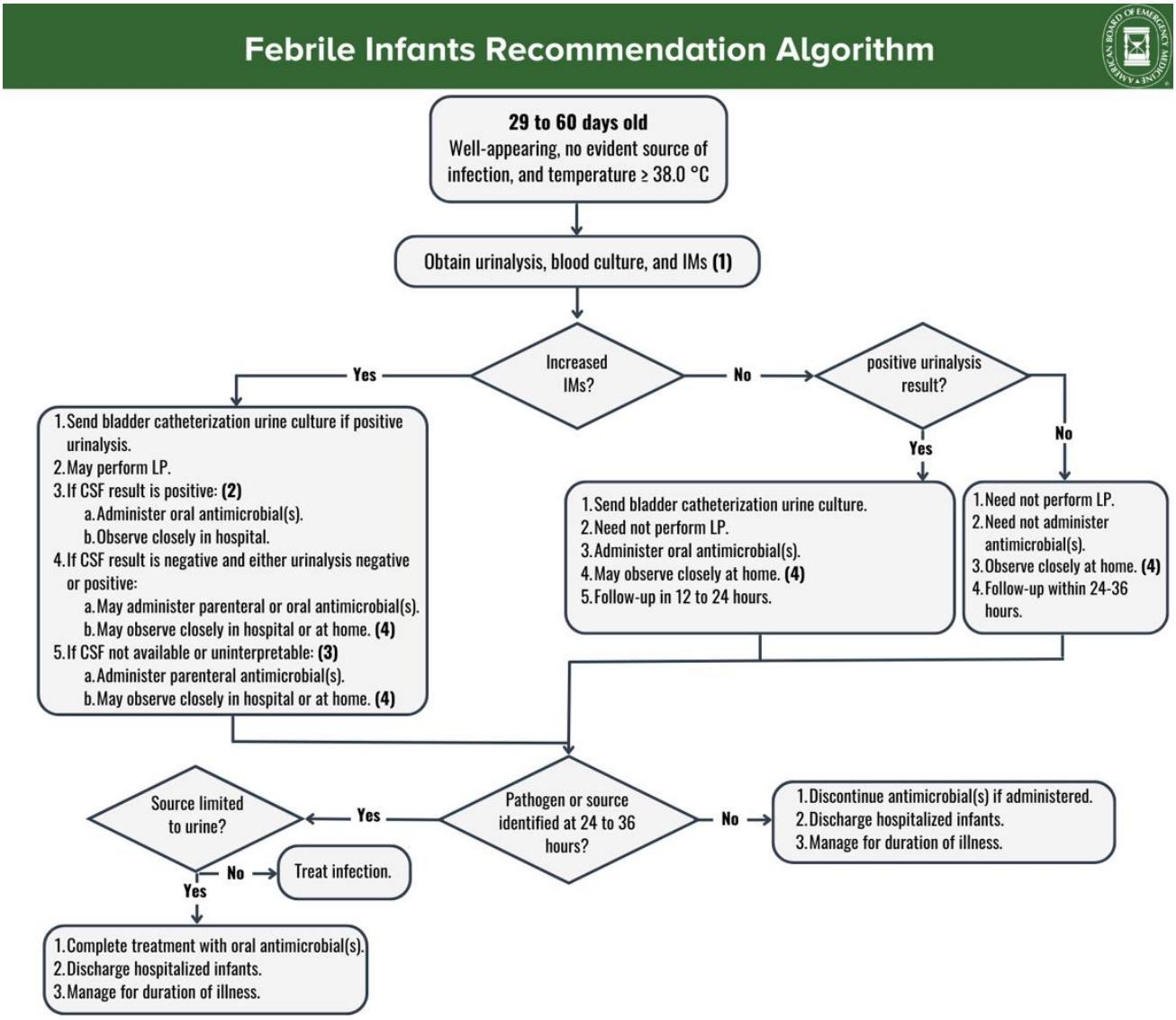
Algorithm for 29- to 60-day-old infants

(1) If available, PCT should be obtained along with ANC. If PCT is unavailable, ANC and CRP should be obtained, and a temperature >38.5°C is considered abnormal. PCT is considered abnormal at >0.5 mg/mL; CRP is considered abnormal at >20 mg/L; ANC is considered abnormal at >4000 per mm^3 when used in conjunction with PCT or >5200 per mm^3 when PCT is unavailable.

(2) Send CSF for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus PCR (if available) if CSF pleocytosis is present and during periods of increased local enterovirus prevalence. Although uncommon in this age group, HSV should be considered when there is a maternal history of genital HSV lesions and in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. Recommended HSV studies are CSF PCR; HSV surface swabs of mouth, nasopharynx, conjunctivae, and anus for HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR.

(3) If CSF is unobtainable or uninterpretable, there are insufficient data to make a specific recommendation. Options include the following: observe without treatment for a period of time and, depending on infant clinical condition, repeat LP and/or laboratory markers; begin empirical antimicrobial agents and reassess in 24 hours on the basis of infant response and results of blood culture; if CSF is bloody or antimicrobial agents have been started previously, analysis by multiplex PCR can add additional information; consult with a local pediatric infectious disease specialist.

(4) Infant may be managed at home if parent and clinician agree that the following are present: reliable phone and transportation, parent willingness to observe and communicate changes in condition, and agreement to the infant being reevaluated in 24 hours. Most 29- to 60-day-old infants with negative IMs and urinalysis results may be observed at home. However, hospital observation is an option for infants when there are barriers to follow-up.



Adapted with permission from Robert H. Pantell, Kenneth B. Roberts, William G. Adams, Benard P. Dreyer, Nathan Kuppermann, Sean T. O'Leary, Kymika Okechukwu, Charles R. Woods Jr., SUBCOMMITTEE ON FEBRILE INFANTS; Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old. Pediatrics August 2021; 148 (2): e2021052228. 10.1542/peds.2021-052228

Editor's notes:

This new policy guideline increases the specificity of detecting bacteremia and/or meningitis while maintaining acceptable sensitivity. Clinicians will differ in thresholds for testing and intervention.

A full sepsis workup, LP, antimicrobials, and admission are required in infants 8-21 days old. A tailored approach begins with the 22- to 28-day-old group and includes the incorporation of IMs. There are more options for investigation, treatment, and disposition in the 29- to 60-day-old group.

These guidelines should not deter the thoughtful physician from a more conservative approach as needed; as an option, they allow for a full sepsis workup, LP, antibiotics, and admission for all age categories, 8-60 days.

The spirit of this policy is to empower the physician to choose the best plan of care for the individual infant—consistent with available evidence—in the context of resources, expectations, risk tolerance, and harm reduction.

Resources for additional learning:

Pediatric Emergency Playbook: The Febrile Infant: https://pemplaybook.org/podcast/the-febrile-infant

Pediatric EM Morsels: Febrile Infants 8 to 28 Days: https://pedemmorsels.com/pediatric-fever-update-febrile-infants-8-to-28-days-old/

Pediatric EM Morsels: Febrile Infants 29 to 60 Days: https://pedemmorsels.com/pediatric-fever-update-febrile-infants-29-to-60-day-old/

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KEY ADVANCES
PRACTICE ADVANCE

Use of the HEART Score in the Evaluation and Management of Emergency Department Patients with Chest Pain

Updated May 2024

Why is this topic important? Patients with chest pain lacking clear evidence of acute coronary ischemia present a frequent challenge to the emergency department (ED) physician who seeks to balance a safe disposition home for ongoing care with a potentially unnecessary admission. The HEART (history, ECG, age, risk factors, and troponin) score offers an evidence-based management algorithm for those patients with "low to moderate risk for short-term harm" chest pain in the ED.

How will this change my clinical practice? The HEART score is a risk-stratification tool that uses information available at the time of presentation for ED patients with chest pain. The score seeks to identify a patient's short-term risk for a major adverse cardiac event (MACE). In recent studies (original, validation, and meta-analyses), patients with a low HEART score (0-3) had a <3% risk (2.5%) of a MACE at 6 weeks after presentation. The HEART pathway may help to identify ED patients with chest pain to safely decrease cardiac testing and reduce length of stay by increasing early discharge rates.

Synopsis Focus Points: Emergency physicians are recommended to use the HEART score and pathway as a clinical decision aid. Depending on local and individual patient resources, patients with a low (0-3) HEART score may be discharged from the ED with follow-up.

Background:
The American College of Cardiology/American Heart Association recommend serial cardiac markers followed by some sort of provocative or objective cardiac testing in patients with chest pain outside clear evidence of cardiac ischemia. (1) The criterion standard used by cardiologists—the thrombolysis in myocardial infarction (TIMI) and The Global Registry of Acute Coronary Events (GRACE) scores—stratified patients with proven or highly suspected acute

coronary syndrome (ACS), not patients who presented to the ED with chest pain. This creates a potential referral bias.

The HEART score is a composite risk-stratification tool that uses information readily available to the emergency physician at the point when a disposition and plan must be made. (2,3) The original study by Six et al. found a 2.5% rate of MACE in patients presenting with a HEART score of 0 to 3. (4) In a validation study that compared HEART with TIMI and GRACE scores, there was a 1.7% rate of MACE in patients at 6 weeks. When evaluating the same patient, the score is reproducible and reliable among physicians. (5) Two recent meta-analyses of HEART score studies confirmed these findings. (6, 7) Green et al. later performed a methodologic appraisal of the literature and reported that the original score may have important weaknesses in interrater reliability and outcome selection. They reported that the summary performance showed pooled sensitivities of 96% to 97%, with lower than previously reported confidence interval bounds of 93% to 94% (8). These authors wrote that they believed the HEART score not to be as reliable as regarded previously.

The HEART pathway incorporates the score into a clinical algorithm with serial troponin tests.

2024 Updates:

- A multicentered study demonstrated that the HEART pathway incorporating high-sensitivity troponin can decrease resource utilization without adversely affecting 30-day all-cause mortality. (9)

- A recent systematic review adds further evidence that there is a very low risk of 30-day MACE with HEART score of 3 or less, but also highlights that, after MI is ruled out by validated high-sensitivity troponin, existing risk prediction tools may have a limited incremental value in identifying patients likely to benefit from noninvasive testing. (10)

The American College of Emergency Physicians (ACEP) clinical policy on non–ST-elevation ACS recommends the HEART score can be used as a clinical prediction instrument (ACEP Level B). (11) For some clinicians, even a 2% risk is high, but given potential efficient outpatient diagnostic capabilities and progressively tighter criteria for admission, the HEART score offers an ED valid and relevant risk assessment tool. Its extant and ubiquitous nature makes the HEART score an important point of reference, but clinicians should be cautioned that the approach to chest pain, in particular, should be patient-, context-, and resource-specific.

This is Level 1a evidence. (12)

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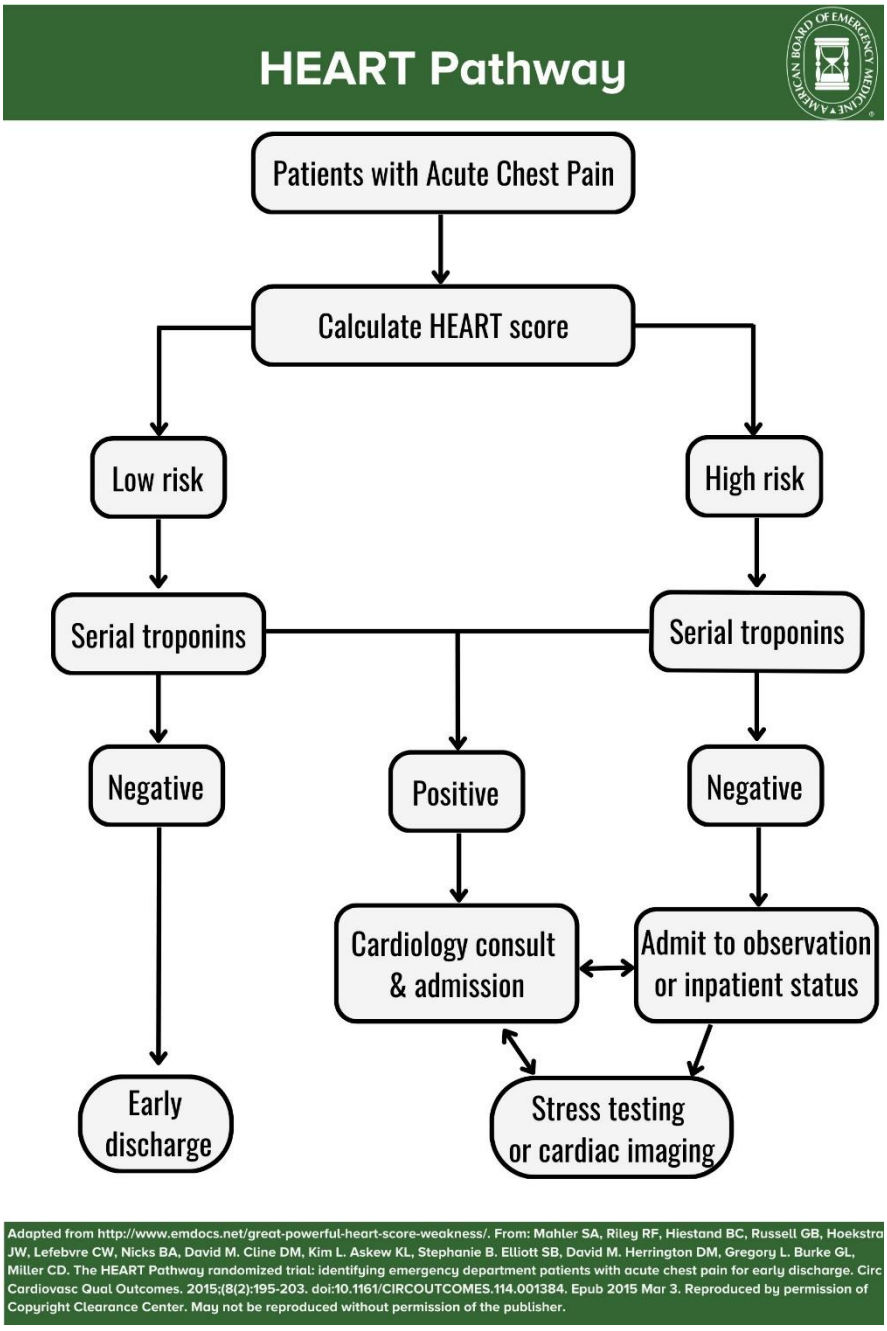
The HEART Score for Chest Pain Patients in the ED

History	Highly Suspicious	2 points
	Moderately Suspicious	1 point
	Slightly or Non-Suspicious	0 points
ECG	Significant ST-Depression	2 points
	Nonspecific Repolarization	1 point
	Normal	0 points
Age	≥ 65 years	2 points
	> 45 - < 65 years	1 point
	≤ 45 years	0 points
Risk Factors	≥ 3 Risk Factors or History of CAD	2 points
	1 or 2 Risk Factors	1 point
	No Risk Factors	0 points
Troponin	≥ 3 x Normal Limit	2 points
	>1 - < 3 x Normal Limit	1 point
	≤ Normal Limit	0 points

Risk Factors: DM, current or recent (<one month) smoker, HTN, HLP, family history of CAD, & obesity

Score 0 – 3: 2.5% MACE over next 6 weeks → Discharge Home
Score 4 – 6: 12 - 16% MACE over next 6 weeks → Admit for Clinical Observation
Score 7 – 10: 72.7% MACE over next 6 weeks → Early Invasive Strategies

Source: Rezaie S. The HEART score: a new ED chest pain risk stratification score. REBEL EM blog. January 10, 2014. Available at: https://rebelem.com/heart-score-new-ed-chest-pain-risk-stratification-score/



Adapted from http://www.emdocs.net/great-powerful-heart-score-weakness/. From: Mahler SA, Riley RF, Hiestand BC, Russell GB, Hoekstra JW, Lefebvre CW, Nicks BA, David M. Cline DM, Kim L. Askew KL, Stephanie B. Elliott SB, David M. Herrington DM, Gregory L. Burke GL, Miller CD. The HEART Pathway randomized trial: identifying emergency department patients with acute chest pain for early discharge. Circ Cardiovasc Qual Outcomes. 2015;(8(2):195-203. doi:10.1161/CIRCOUTCOMES.114.001384. Epub 2015 Mar 3. Reproduced by permission of Copyright Clearance Center. May not be reproduced without permission of the publisher.

Resources for additional learning:
https://pubmed.ncbi.nlm.nih.gov/?term=heart+score+acute+coronary+syndrome
http://thesgem.com/2016/04/sgem151-groove-is-in-the-heart-pathway/
https://rebelem.com/is-it-time-to-start-using-the-heart-pathway-in-the-emergency-department/

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KEY ADVANCES
CLINICAL POLICY ALERT

Emergency Department Evaluation and Management of Hypertensive Disorders of Pregnancy

Updated May 2024

Gestational hypertension and preeclampsia: ACOG Practice Bulletin, Number 222. Obstet Gynecol. 2020;135(6):e237-e260. doi:10.1097/AOG.0000000000003891. PMID: 32443079. https://pubmed.ncbi.nlm.nih.gov/32443079/ (1)

Policy Recommendations and Focus Points in bold

What is the optimal treatment for women with gestational hypertension, preeclampsia, or eclampsia?

Definitions and Diagnostic Criteria

Diagnostic Criteria for Gestational Hypertension
Systolic blood pressure ≥ 140 mmHg OR diastolic pressure ≥ 90 mmHg on two measurements, at least 4 hours apart, after 20 weeks of gestation, in a woman with previously normal blood pressure.

All patients with gestational hypertension should be screened for severe features that would automatically qualify them for preeclampsia with severe features (see below).

Diagnostic Criteria for Preeclampsia
Systolic blood pressure ≥ 140 mmHg OR diastolic blood pressure ≥ 90 mmHg, on two measurements, 4 hours apart, after 20 weeks of gestation, in a woman with previously normal blood pressure.

-OR-

Systolic blood pressure ≥ 160 mmHg OR diastolic blood pressure ≥ 110 mmHg. (Severe hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy).

AND either:

a) Proteinuria: 300 mg or more per 24-hour urine collection or protein creatinine ratio of 0.3 or greater or dipstick reading of 2+ or greater
b) One or more of the following in the absence of proteinuria: thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, or headache not otherwise explained and unresponsive to medication

Diagnostic Criteria for Preeclampsia *with* Severe Features
The presence of ANY of the following features in a patient with gestational hypertension or preeclampsia meets the definition of preeclampsia with severe features:

- Systolic blood pressure ≥ 160 mmHg, diastolic blood pressure ≥ 110 mmHg on two measurements at least 4 hours apart (unless treated before second measurement)
- Platelets: thrombocytopenia (< 100 x 10^9/L)
- Liver function: impaired liver function without other cause; liver enzymes greater than twice normal levels
- Renal insufficiency: > 1.1 mg/dL or doubling of the previous creatinine level
- Pulmonary edema
- Headache without other identified cause and unresponsive to medication
- Visual disturbances

Eclampsia
Eclampsia is the convulsive manifestation of the hypertensive disorders of pregnancy defined by new-onset tonic-clonic, focal, or multifocal seizures in the absence of other causative conditions.

Patient Management Recommendations:

Level A Recommendations

Magnesium sulfate should be used for the prevention and treatment of seizures in patients with severe gestational hypertension and preeclampsia with severe features or eclampsia. Although optimal dosage has not been established, the following regimens for intravenous (IV) and intramuscular (IM) magnesium administration have been promulgated:

- IV administration: 4-6 g magnesium sulfate over 20-30 minutes, followed by 1-2 g/h infusion
- IM administration: 10 g IM (5 g in each buttock) followed by 5 g every 4 hours (the medication can be mixed with 1 mL of 2% lidocaine to mitigate the pain with IM injection)

For patients with gestational hypertension or preeclampsia without severe features at or beyond 37 0/7 weeks of gestation, delivery rather than expectant management upon diagnosis is recommended.

Level B recommendations (see below)

Delivery is recommended when severe gestational hypertension or preeclampsia with severe features is diagnosed at or beyond 34 0/7 weeks of gestation, after maternal stabilization or with labor or prelabor rupture of membranes. Delivery should not be delayed for the administration of steroids in the late preterm period.

Antihypertensive treatment should be initiated expeditiously for acute-onset severe hypertension (i.e., systolic blood pressure of 160 mmHg or greater or diastolic blood pressure of 110 mmHg or greater, or both) that is confirmed as persistent (15 minutes or more). The available literature suggests that antihypertensive agents should be **administered within 30-60 minutes of the diagnosis**. However, it is recommended to administer antihypertensive therapy as soon as reasonably possible after the criteria for acute-onset severe hypertension is met. (2)

If IV access is available, either labetalol or hydralazine may be used for acute control of hypertension. Hydralazine may be administered IM, but IV is preferred. Oral nifedipine can be used if IV access cannot be obtained.

The expectant management of preeclampsia with severe features before 34 0/7 weeks of gestation is best accomplished in a setting with resources appropriate for maternal and neonatal care. Because expectant management is intended to provide neonatal benefit at the expense of maternal risk, expectant management is not advised when neonatal survival is not anticipated. **During expectant management, delivery is recommended at any time in the case of deterioration of maternal or fetal condition.**

Oral medication (labetalol or nifedipine) can be administered for expectant management. (3)

What is the optimal treatment for eclampsia?

Patient Management Recommendations:

Level A recommendations

Magnesium sulfate (IM or IV) should be used for the prevention and treatment of seizures in women with severe gestational hypertension and preeclampsia with severe features or eclampsia.

Level B recommendations (none specified)
Level C recommendations (none specified)

What is the management of acute complications for preeclampsia with hemolysis, elevated liver enzymes, and low platelet (HELLP) syndrome?

Patient Management Recommendations:

Level A recommendations (none specified)
Level B recommendations (none specified)
Level C recommendations (see below)

It is recommended that women with gestational hypertension in the absence of proteinuria are diagnosed with preeclampsia if they present with any of the following severe features: thrombocytopenia (platelet count $<100 \times 10^9$/L); impaired liver function, as indicated by abnormally elevated blood concentrations of liver enzymes (to twice the upper limit of normal concentration);

severe persistent right upper quadrant or epigastric pain and not accounted for by alternative diagnoses; renal insufficiency (serum creatinine concentration >1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease); pulmonary edema or new-onset headache unresponsive to acetaminophen and not accounted for by alternative diagnoses; or visual disturbances.

For HELLP syndrome, treatment of preeclampsia as otherwise specified plus supportive care is recommended. There is insufficient evidence to support use of corticosteroids in this condition.

American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics. ACOG Practice Bulletin No. 203: chronic hypertension in pregnancy. *Obstet Gynecol.* 2019;133(1):e26-e50. doi:10.1097/AOG.0000000000003020. PMID: 30575676 (4)

How is chronic hypertension distinguished from superimposed preeclampsia?

Level A recommendations (none specified)
Level B recommendations (none specified)
Level C recommendations (see below)

In cases of diagnostic uncertainty in discriminating transient blood pressure increases in chronic hypertension from superimposed preeclampsia, particularly with severe-range blood pressures, initial surveillance in the hospital setting is recommended.

Workup should include evaluation of hematocrit, platelets, creatinine, and liver function tests, as well as assessment of new-onset proteinuria. Serum uric acid may be a helpful marker. Elevated hematocrit (indicating hemoconcentration), thrombocytopenia, hyperuricemia, new-onset or worsening proteinuria, elevated serum creatinine, and elevated liver transaminases are more indicative of preeclampsia than chronic hypertension and, from a practical point of view, the practitioner should first consider preeclampsia.

Fetal well-being should be assessed as appropriate with fetal heart rate monitoring and sonography.

Serial blood pressure assessment over 4 to 8 hours can be helpful in discriminating acute and serious increases in blood pressure from transient hypertension.

What treatment should be used for pregnant women with chronic hypertension, and what are the goals of treatment?

Level A recommendations (none specified)
Level B recommendations (see below)

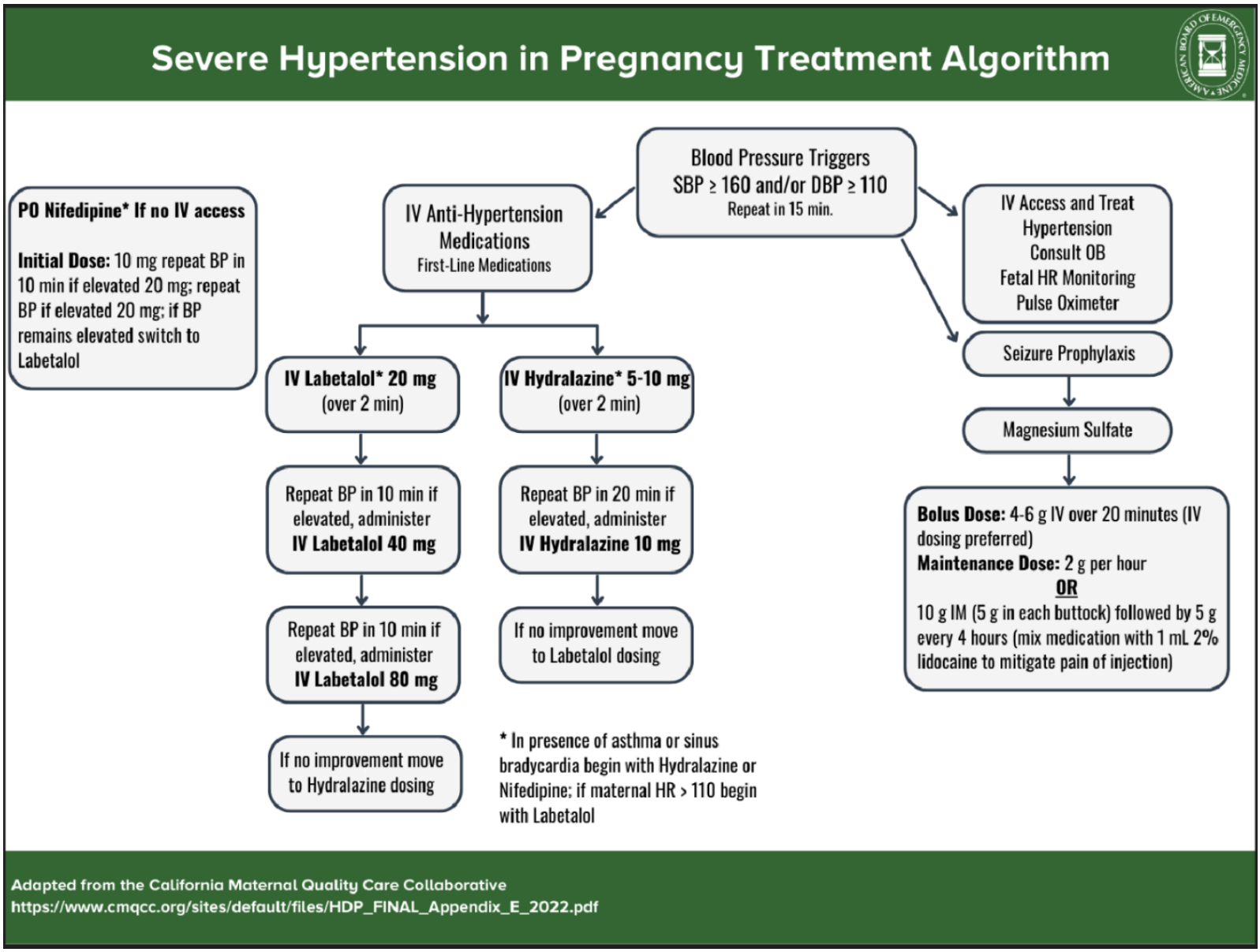
Antihypertensive treatment should be initiated expeditiously for acute-onset severe hypertension (i.e., systolic blood pressure of 160 mmHg or greater or diastolic blood pressure of 110 mmHg or greater, or both) that is confirmed as persistent (15 minutes or more). The available literature suggests that antihypertensive agents should be **administered within 30-60 minutes of the diagnosis**. However, it is recommended to administer antihypertensive therapy as soon as reasonably possible after the criteria for acute-onset severe hypertension are met.

Women with severe acute hypertension that is not controlled with traditional chronic antihypertensive regimens or women who develop superimposed preeclampsia with severe features should be delivered upon diagnosis at 34 0/7 weeks of gestation or more. Because of the significant maternal–fetal and maternal–neonatal morbidity, **immediate delivery** after maternal

stabilization is recommended if any of the following are present at any gestational age in **women with superimposed preeclampsia: uncontrollable severe hypertension, eclampsia, pulmonary edema, disseminated intravascular coagulation, new or increasing renal insufficiency, placental abruption, or abnormal fetal testing.**

Level C recommendations (see below)

It is recommended to maintain blood pressure levels for pregnant women with chronic hypertension treated with antihypertensive medications at or above 120 mmHg but below 160 mmHg systolic and at or above 80 mmHg but below 110 mmHg diastolic.



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Clinical findings and strength of recommendations regarding patient management were made according to the following criteria:

Level A recommendations
Recommendations are based on good and consistent scientific evidence.

Level B recommendations
Recommendations are based on limited or inconsistent scientific evidence.

Level C recommendations
Recommendations are based primarily on consensus and expert opinion.

Resources for Additional Learning:

https://emergencymedicinecases.com/pre-eclampsia-preterm-labor-management/

https://coreem.net/podcast/episode-113-0/

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KEY ADVANCES
CLINICAL POLICY ALERT

2020 and 2024 Update on Neonatal Resuscitation

Updated May 2024

Aziz K, Lee HC, Escobedo MB, Hoover AV, Kamath-Rayne BD, Kapadia VS, et al. Part 5: Neonatal Resuscitation: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020;142(16 Suppl 2):S524-S550. Available via PubMed at http://pmid.us/33081528

Sawyer T, McBride ME, Ades A, Kapadia VS, Leone TA, Lakshminrusimha S, Ali N, Marshall S, Schmölzer GM, Kadlec KD, Pusic MV, Bigham BL, Bhanji F, Donoghue AJ, Raymond T, Kamath-Rayne BD, de Caen A. Considerations on the use of neonatal and pediatric resuscitation guidelines for hospitalized neonates and infants: on behalf of the American Heart Association Emergency Cardiovascular Care Committee and the American Academy of Pediatrics. Pediatrics. 2024 Jan 1;153(1):e2023064681. doi:10.1542/peds.2023-064681. PMID: 38105696.

Policy Recommendations and Focus Points in bold

Newborn resuscitation requires anticipation and preparation by providers who train individually and as teams.

- Every birth should be attended by at least one person who can perform the initial steps of newborn resuscitation (i.e., dry, warm, and stimulate) and initiate positive pressure ventilation, and whose only responsibility is the care of the newborn. *Class of Recommendation 1, Strong*
- Before every birth, a standardized risk assessment tool should be used to assess perinatal risk and assemble a qualified team on the basis of risk. *Class of Recommendation 1, Strong*
- Before every birth, a standardized equipment checklist should be used to ensure the presence and function of supplies and equipment necessary for a complete resuscitation. *Class of Recommendation 1, Strong*
- When anticipating a high-risk birth, a pre-resuscitation team briefing should be completed to identify potential interventions and assign roles and responsibilities. *Class of Recommendation 1, Strong*

Most newly born infants do not require immediate cord clamping or resuscitation and can be evaluated and monitored during skin-to-skin contact with their mothers after birth.

- **For term and late preterm** newborn infants ≥34 weeks' gestation who do not require resuscitation, delayed cord clamping (DCC) (≥30 seconds) can be beneficial when compared to early cord clamping (<30 seconds). *Class of (Recommendation 2a, LOE B-R)*
- **For nonvigorous term and late preterm** infants (35–42 weeks' gestation), intact cord milking may be reasonable when compared to early cord clamping (<30 seconds). (Recommendation 2b, LOE B-R)
- **For term and late preterm** newborn infants ≥34 weeks' gestation who do not require resuscitation, intact cord milking is not known to be beneficial when compared to DCC (≥30 seconds). (Recommendation 3: No benefit, LOE C-LD)
- **For preterm newborn infants <34 weeks'** gestation who do not require resuscitation, DCC (≥30 seconds) can be beneficial when compared to early cord clamping (<30 seconds). (Recommendation 2a, LOE B-R)
- For preterm newborn infants <28 weeks' gestation, intact cord milking is not recommended. (Recommendation 3: No benefit, LOE B-R)

Inflation and ventilation of the lungs are the priority in newly born infants who need support after birth.

- For newly born infants, after drying, warming, and stimulating, who remain cyanotic and with poor respiratory effort, or with heart rate (HR) <100 bpm, provide positive pressure ventilation at a rate of 40 to 60 inflations per minute. *Class of Recommendation 2a, Moderate*
- *It can be beneficial to use a T-piece resuscitator instead of a self-inflating bag, with or without a positive end-expiratory pressure valve, for administering positive-pressure ventilation to newborn infants, particularly for preterm infants. (Recommendation 2a, LOE B-NR)*
- *It may be reasonable to use a supraglottic airway as the primary interface to administer Positive Pressure Ventilation (PPV) instead of a face mask for newborn infants delivered at ≥34 0/7 weeks' gestation. (Recommendation 2b, LOE C-LD)*
- In preterm newly born infants, the routine use of sustained inflations to initiate resuscitation is potentially harmful and should not be performed. *Class of Recommendation 3, Harm, Strong*

A rise in HR is the most important indicator of effective ventilation and response to resuscitative interventions.

- In newly born infants who are gasping or apneic within 60 seconds after birth or are persistently bradycardic (HR <100 bpm) despite appropriate initial actions, positive pressure ventilation should be provided without delay. *Class of Recommendation 1, Strong*

Pulse oximetry is used to guide oxygen therapy and meet oxygen saturation goals.

- In term and late preterm newborns (35 weeks or more of gestation) receiving respiratory support at birth, 100% oxygen should not be used because it is associated with excess mortality. *Class of Recommendation 3, Harm*

In the Table below, see the targeted preductal saturations during the first 10 minutes after birth. At 60 seconds, 60% is the target, with an increase of 5% every minute until 5 minutes of life when pulse oximetry is 80-85%. Some newborns will have higher pulse oximeter readings, but the table demonstrates acceptable values that are achieved for most newborns.

Time Since Birth	Projected Pulse Oximeter Over Time
1 minute	60-65%
2 minutes	65-70%
3 minutes	70-75%
4 minutes	75-80%
5 minutes	80-85%
10 minutes	85-90%
Initial Oxygen Concentration for Positive-Pressure Ventilation	
>/= 35 Weeks GA	21% Oxygen
< 35 Weeks GA	21-30% Oxygen

Chest compressions are provided if there is a poor HR response to ventilation after appropriate ventilation corrective steps, which preferably include endotracheal intubation.

- If HR after birth remains at <60 bpm despite adequate ventilation for at least 30 seconds, initiate chest compressions. *Class of Recommendation 2a, Moderate*

The following Table illustrates actions to be taken during resuscitation of the newly born.

Heart Rate (bpm)	Respiratory Distress/Apnea	Central Cyanosis Present	Intervention
>100	No	Yes	Oxygen if needed Consider CPAP
—	Yes	Yes/No	BMV Cardiac Monitor
60-100	—	—	Continue ventilation with BMV; consider Supraglottic Airway / ETT Cardiac Monitor
<60	—	—	Supraglottic Airway / ETT Chest compressions UVC

BMV, bag-mask ventilation. ETT, endotracheal tube. UVC, umbilical vein catheter. CPAP, continuous positive airway pressure.

- The benefit of 100% oxygen compared with 21% oxygen (air) or any other oxygen concentration for ventilation during chest compressions is uncertain. It may be reasonable to use higher concentrations of oxygen when chest compressions are being delivered. *Class of Recommendation 2b, Weak*

The HR response to chest compressions and medications should be monitored electrocardiographically.

- During chest compressions, ECG should be used for the rapid and accurate assessment of HR. *Class of Evidence 1, Strong*

If the response to chest compressions is poor, it may be reasonable to provide epinephrine, preferably via the intravenous (IV) route.

- If HR has not increased to 60 bpm or more after optimizing ventilation and chest compressions, administer intravascular (IV or intraosseous [IO]) epinephrine (0.01 to 0.03 mg/kg). *Class of Recommendation 2b, Weak*

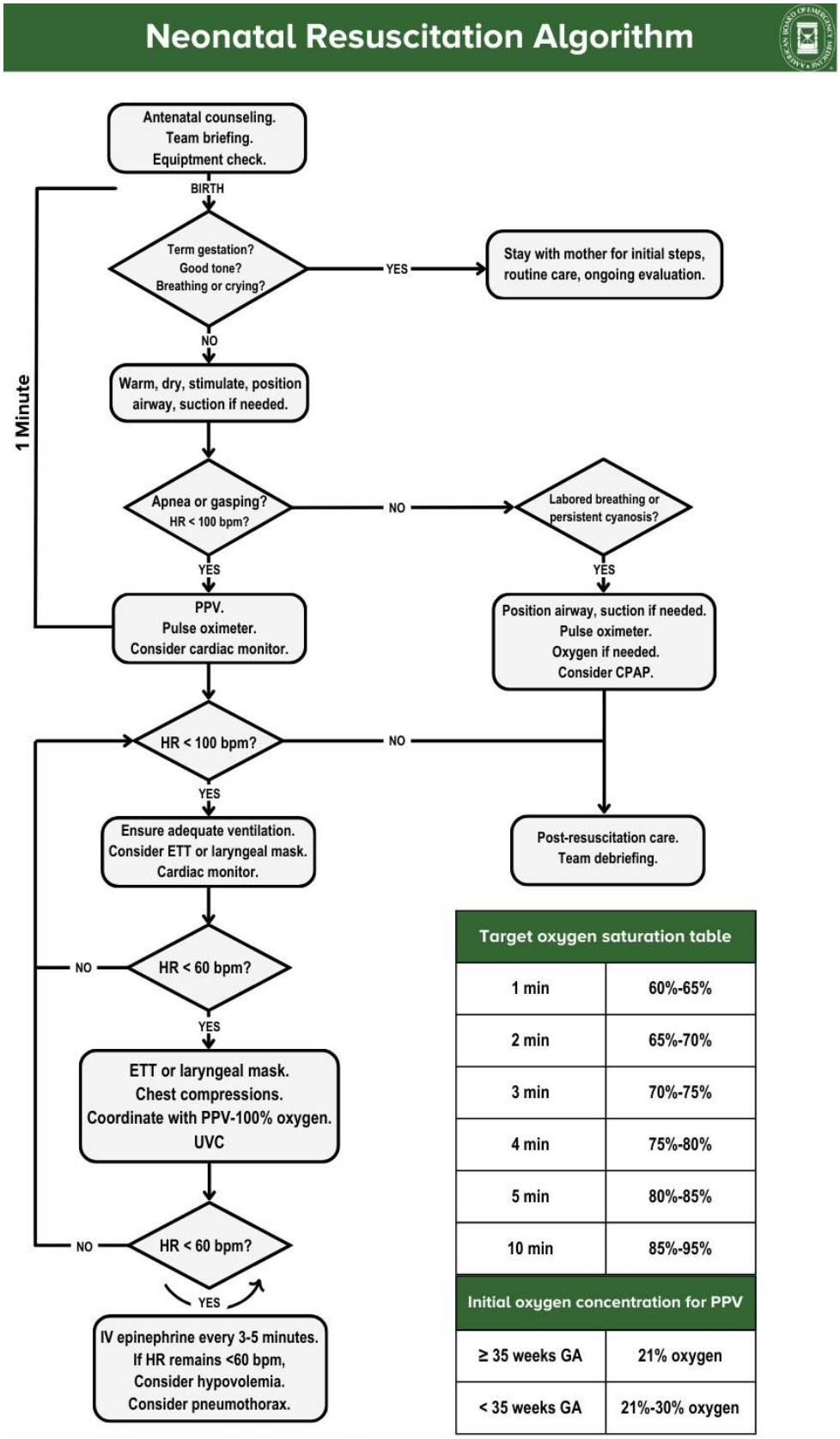
Failure to respond to epinephrine in a newborn with history or examination consistent with blood loss may require volume expansion.

- It may be reasonable to provide volume expansion with normal saline or blood at 10 to 20 mL/kg. *Class of Recommendation 2b, Weak*

If all of these steps of resuscitation are completed effectively and there is no HR response by 20 minutes, redirection of care should be discussed with the team and family.

- In newly born infants receiving resuscitation, if there is no HR and all of the steps of resuscitation have been performed, cessation of resuscitation efforts should be discussed with the team and the family. A reasonable time frame for this change in goals of care is approximately 20 minutes after birth. *Class of Recommendation 1, Strong*
- If a birth is at the lower limit of viability or involves a condition likely to result in early death or severe morbidity, non-initiation or limitation of neonatal resuscitation is reasonable after expert consultation and parental involvement in decision making. *Class of Recommendation 2a, Moderate*
- Non-initiation of resuscitation and discontinuation of life-sustaining treatment during or after resuscitation should be considered ethically equivalent. *Class of Recommendation 1, Strong*

Graphic 1. Neonatal Resuscitation Algorithm



Adapted from the NRP 8th Edition algorithm from American Academy of Pediatrics.
Abbreviations: BMV, Bag-mask Ventilation. ETT, Endotracheal Tube. PPV, Positive-Pressure Ventilation. UVC, Umbilical Vein Catheter

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Resources for Additional Learning:

Ali N, Sawyer T. Special consideration in neonatal resuscitation. *Semin Perinatol.* 2022;46:1-8.
Emergency Medicine Cases: https://emergencymedicinecases.com/neonatal-resuscitation/

American Heart Association Neonatal Resuscitation Algorithm:
https://www.ahajournals.org/doi/10.1161/CIR.0000000000000902

Normandin PA, Benotti SA. ED Update: Overview of New Neonatal Resuscitation Guidelines. J Emerg Nurs. 2022 Nov;48(6):631-636. doi: 10.1016/j.jen.2022.08.008. PMID: 36357120.

https://www.nrplearningplatform.com/instructor-toolkit/assets/Instructor_ToolKit/RESOURCES/DocumentsAndForms/resources/NRP%208th-Ed%20ITK%20Algorithm%20w%20logos.pdf

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KEY ADVANCES
CLINICAL POLICY ALERT

Ensuring Optimal Outcomes for Children by Improving Pediatric Readiness in the Emergency Department

Updated May 2024

Remick K, Gausche-Hill M, Joseph MM, Brown K, Snow SK, Wright JL. Pediatric readiness in the emergency department. Ann Emerg Med. 2018;72(6):e123-e136. PMID: 30392738

Remick K, Gausche-Hill M, Joseph MM, Brown K, Snow SK, Wright JL. Pediatric readiness in the emergency department. Pediatrics. 2018;142(5):e20182459. doi:10.1542/peds.2018-2459. PMID: 30389843

Remick K, Gausche-Hill M, Joseph MM, Brown K, Snow SK, Wright JL. Pediatric readiness in the emergency department. J Emerg Nurs. 2019;45(1):e3-e18. doi:10.1016/j.jen.2018.10.003. PMID: 30392719

Why is this topic important?
Few emergency physicians (EPs) or emergency departments (EDs) routinely treat critically ill pediatric patients. Improving pediatric readiness among EPs and all community EDs improves outcomes, including mortality for pediatric patients. In 2018, guidelines for care of children were revised and approved by the 3 sponsoring organizations (American College of Emergency Physicians [ACEP], American Academy of Pediatrics [AAP], and Emergency Nurses Association [ENA]). (1-3) These guidelines delineate the recommended practices and resources needed to prepare EDs to care for pediatric patients. More than 80% of children who seek emergency care present to general EDs versus specialized pediatric EDs. **Emerging data demonstrate that high pediatric readiness in the ED is associated with reductions in mortality for children with critical illness and injury and reductions in health care disparities.**

Policy Recommendations and Focus Points in bold

Recommendations to improve pediatric readiness were made in 7 domains:

I Administration and Coordination for the Care of Children in the ED
II Competencies for Physicians, Advanced Practice Providers, Nurses, and Other Health Care Providers
III Quality Improvement/Performance Improvement in the ED
IV Policies, Procedures, and Protocols for the ED
V Pediatric Patient and Medication Safety in the ED
VI Support Services for the ED
VII Equipment, Supplies, and Medications

Administration and Coordination for the Care of Children in the ED

- **Two pediatric emergency care coordinators (PECCs)** – **A physician coordinator identified by the ED medical director and a registered nurse coordinator identified by the ED nurse director should be assigned** to the ED to ensure that all recommendations made in these guidelines are implemented and to ensure appropriate education and competencies of staff.
- The physician and nurse PECC roles may have additional roles assigned in the ED (i.e., quality director or clinical nurse educator), or may be shared in multiple facilities within a hospital system.
- The PECC role is central to pediatric readiness and has been found to improve pediatric readiness of EDs, as shown in "A National Assessment of Pediatric Readiness" measured by a weighted pediatric readiness score (WPRS), and to have improved availability of pediatric quality improvement plans, policies and protocols, and vital equipment in the ED. (1)

Competencies for Physicians, Advanced Practice Providers, Nurses, and Other Health Care Providers

- **All nurses and physicians staffing the ED should have the necessary knowledge, skills, and training to care for children of all ages**.
- **Evaluation of competencies for physicians caring for children may be met through participation in continuing certification programs in emergency medicine or pediatric emergency medicine**.
- Other activities may achieve competency in caring for children but must be evaluated through direct observation, chart reviews, or written evaluations.

Quality Improvement/Performance Improvement in the ED

- Quality improvement activities should address the following 6 domains as addressed by the National Academy of Medicine: Safe, Equitable, Patient-Centered, Timely, Efficient, and Effective.
- Quality improvement and performance improvement plans should include pediatric indicators and integrate findings from other services that care for children, including emergency medical services, inpatient services (e.g., medical surgical unit), and regional pediatric centers..

Policies, Procedures, and Protocols for the ED

- Policies, procedures, and protocols should be developed that meet critical needs for identification and management of critical illness; establish best practice for coordination of care, including in disasters; and ensure that appropriate communication occurs for reporting child maltreatment.

Pediatric Patient and Medication Safety in the ED

- **Patient safety of children can be optimized by weighing and recording weights of children in kilograms only**; without conversion or calculation.
- Children who require resuscitation and cannot be weighed easily can have an estimate of their weight determined by a length-based resuscitation tape (e.g., Broselow-Luten tape).
- **Employ strategies to ensure safe medication dosing determination and delivery.**

Support Services for the ED

- Support services, such as medical imaging, should have procedures to use weight-based reductions in dosing ionizing radiation using the ALARA (as low as reasonably achievable) principle and develop policies that integrate clinical decision rules for appropriate ordering of diagnostic studies.

Equipment, Supplies, and Medications

- The ED should have equipment and supplies that are logically organized by weight-based color coding or other method to clearly identify appropriate-sized equipment for children of all ages.
- Staff should be educated on the location of all resuscitation equipment and supplies for children and have a daily method to verify that all sizes are present and functional.

Impact of High Pediatric Readiness on Patient Outcome

The National Pediatric Readiness Project (NPRP) is a multidisciplinary quality improvement project sponsored by ACEP, AAP, and ENA, whose mission is ensuring emergency care for all children. The NPRP supports a national assessment of pediatric readiness in EDs. The first assessment was published in 2013 and 83% of EDs responded (4). The last assessment was published in 2021 and 71% of EDs responded, demonstrating high engagement in this initiative, despite the ongoing COVID-19 pandemic. (5) The WPRS is an assessment tool that is normalized to a 100-point scale. The overall national median score was 69 out of 100 possible points. **The presence of pediatric emergency care coordinator (PECC), having a quality improvement plan that included children, and staffing the ED with board certified emergency physicians were significantly associated with higher pediatric readiness in EDs.** Data from these assessments were used to evaluate the impact of ED pediatric readiness and patient outcomes, specifically trauma injury and medical illness mortality.

- Ames et al. demonstrated that EDs with the highest quartile pediatric readiness scores reported a **4-fold lower rate of mortality for children with critical illness compared with EDs** with lower readiness scores. (6)
- Newgard et al. found, in a study of more than 800 EDs in the United States with trauma centers, that those children treated initially in the highest quartile scoring EDs, as measured by the WPRS, **had half the risk of death, and that this benefit persisted for 1 year post care. (7,8)**
- Newgard et al. further demonstrated in a study of 796,937 children cared for in 983 EDs, that for **the highest pediatric-ready EDs (WPRS >88), there were 60% and 76% lower odds of in-hospital death for children with traumatic injury and medical illness, respectively.** These findings demonstrated that the mortality benefit persisted to 1 year after the hospitalization. Furthermore, if all EDs had high pediatric readiness, an estimated 1442 pediatric deaths may have been prevented.(9)
- Jenkins et al., in a study in of 586 EDs in 11 states, found that racial and ethnic disparities in mortality exist for medical patients, but not for trauma patients; however, high readiness was associated with a significant reduction in these outcomes. Therefore, **if all hospitals had high**

pediatric readiness, this would result in an estimated three-fold reduction of disparity in mortality, thus closing the disparity gap. (10)

- Overall, the Pediatric Readiness in the ED guidelines provide a framework for quality improvement that, if implemented successfully, can improve children's access to EDs that are properly staffed and equipped to provide emergency care, reduce racial and ethnic disparities in mortality and, most importantly, ensure optimal outcomes for children with critical illness and injury.

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6. Ames SG, Davis BS, Marin JR, Fink EL, Olson LM, Gausche-Hill M, Kahn JM. Emergency department pediatric readiness and mortality in critically ill children. *Pediatrics.* 2019;144(3):e20190568. PMID: 31444254.
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10. Jenkins PC, Lin A, Ames SG, Newgard CD, Lang B, Winslow JE, Marin JR, Cook JNB, Goldhaber-Fiebert JD, Papa L, Zonfrillo MR, Hansen M, Wall SP, Malveau S, Kuppermann N; Pediatric Readiness Study Group. Emergency department pediatric readiness and disparities in mortality based on race and ethnicity. *JAMA Netw Open.* 2023;6(9):e2332160. doi:10.1001/jamanetworkopen.2023.32160. PMID: 37669053; PMCID: PMC10481245.

Resources for Additional Learning:

Check your EDs readiness: https://www.pedsready.org

EMS for Children Innovation and Improvement Center: https://emscimprovement.center/domains/pediatric-readiness-project/

Pediatric Readiness Checklist: https://emscimprovement.center/domains/pediatric-readiness-project/readiness-toolkit/readiness-ED-checklist/

Pediatric Readiness Toolkit: https://emscimprovement.center/domains/pediatric-readiness-project/readiness-toolkit/readiness-toolkit-checklist/

EMRAP: https://www.emrap.org/episode/emrap20219/national

Pediatric Morsels: https://pedemmorsels.com/national-pediatric-readiness-program/

ACEP Frontline: https://soundcloud.com/acep-frontline/are-you-ready-the-pediatric-readiness-project-2021

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KEY ADVANCES
CLINICAL POLICY ALERT

Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department with Acute Heart Failure Syndromes

New July 2024

Silvers SM, Gemme SR, Hickey S, Mattu, A, Haukoos JS, Diercks DB, Wolf SJ; American College of Emergency Physicians. Ann Emerg Med. 2022 Oct;80(4):e31-e59. doi:10.1016/j.annemergmed.2022.05.027. Erratum in: Ann Emerg Med. 2023 Mar;81(3):383. PMID: 36153055.

Why is this topic important?

- The prevalence of heart failure among adults in the United States has increased by nearly 10% between 2012 (5.7 million Americans) and 2016 (6.2 million Americans). It is estimated that this prevalence will increase another 46% by 2030, to more than eight million individuals.(1)
- Acute heart failure syndrome (AHFS) is the “gradual or rapid deterioration in heart failure signs and symptoms resulting in a need for urgent therapy”.(2)
- AHFS is associated with a 12% mortality rate during the in-hospital treatment period (3) and is often used interchangeably with “acute decompensated heart failure.”
- 5-year case fatality rates after hospitalization for AHFS have been reported to be up to 42%.(1)
- The Emergency Department (ED) plays a critical role in managing AHFS because approximately 80% of patients who are hospitalized for the condition are admitted through the ED.(4)

How will this change my clinical practice? Point-of-care lung ultrasound (LUS), high-dose nitroglycerin, and risk stratification rules should play a significant role in the diagnosis, treatment, and disposition of ED patients with AHFS.

Synopsis Focus Points and Policy Recommendations (in bold):

1. **In adult patients presenting to the ED with suspected AHFS, is the diagnostic accuracy of point-of-care LUS sufficient to direct clinical management?**

Patient Management Recommendations:

- Use point-of-care LUS as an imaging modality in conjunction with medical history and physical examination to diagnose AHFS when diagnostic uncertainty exists as the accuracy of this diagnostic test is sufficient to direct clinical management **(Level B recommendation**).
  - Use of LUS requires that the equipment is available and the physician is proficient in its use.

Highlighted Points:

- Evidence from one Class II and eight Class III studies supports the use of point of care ultrasonography (POCUS) to improve diagnostic accuracy in patients with AHFS and help direct management.
  - Four systematic reviews and meta-analyses, which included more than 9800 patients treated or reviewed by emergency medicine physicians, showed the non-weighted diagnostic performance of LUS alone to be appropriate to guide clinical management in patients with an AHFS.
  - B-lines on bedside ultrasound is an independent predictor of AHFS.
  - When combined with historical information and physical examination findings, bedside LUS outperforms chest radiography and laboratory testing, including natriuretic peptides.

2. **In adult patients presenting to the ED with suspected AHFS, is early administration of diuretics safe and effective?**

Patient Management Recommendations:

- Although no specific timing of diuretic therapy can be recommended, physicians may consider earlier administration of diuretics when indicated for ED patients with acute heart failure syndrome, because it may be associated with reduced length of stay and in-hospital mortality (**Level C consensus recommendation**).
- Physicians should be confident in the diagnosis of AHFS with volume overload in a patient before the administration of diuretics because treatment with diuretics may cause harm to those with an alternative diagnosis (**Level C consensus recommendation**).

Highlighted Points:

- Only one weak Class III study was identified evaluating the safety and efficacy of early administration of diuretics in AHFS. Therefore, no confident recommendations about the timing of diuretics could be made.

3. **In adult patients presenting to ED with suspected AHFS, is vasodilator therapy with high-dose nitroglycerin administration safe and effective?**

Patient Management Recommendations:

- Consider using high-dose nitroglycerin as a safe and effective treatment option when administered to patients with AHFS and elevated blood pressure (**Level C consensus recommendation**).
    - High-dose nitroglycerin has been described as infusion rates of > 200-400 mcg/min or bolus dosing of 500-1000 mcg every three to five minutes.

Highlighted Points:

- Evidence from one Class III study demonstrates the safety and suggests improved clinical outcomes (i.e., reduced intubation, bilevel positive airway pressure [BIPAP] use, and intensive care unit [ICU] admissions) with high-dose nitroglycerine therapy in AHFS.

4. In adult patients presenting to the ED with symptomatic AHFS, is there a defined group that may be safely discharged home for outpatient follow-up?

Patient Management Recommendations:

- Do not rely on current AHFS risk stratification tools alone to determine which patients may be discharged directly home from the ED. (**Level B recommendation**)
- Consider using the Ottawa Heart Failure Risk Scale (OHFRS) to help determine which higher-risk patients for adverse outcome should not be discharged home. (**Level B recommendation**).
- Consider using the Emergency Heart Failure Mortality Risk Grade for 7-day mortality (EHMRG7) or the STRATIFY decision tool to help determine which higher-risk patients for adverse outcome should not be discharged home. (**Level C recommendation**)
- Use shared decision-making strategies when determining the appropriate disposition of patients with AHFS. (**Level C consensus recommendation**)

Highlighted Points:

- Evidence from one Class II and three Class III studies supports the use of AHFS risk tools in combination with shared decision making to assist ED providers in the disposition of patients from the ED.

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1. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, Chang AR, Cheng S, Das SR, Delling FN, Djousse L, Elkind MSV, Ferguson JF, Fornage M, Jordan LC, Khan SS, Kissela BM, Knutson KL, Kwan TW, Lackland DT, Lewis TT, Lichtman JH, Longenecker CT, Loop MS, Lutsey PL, Martin SS, Matsushita K, Moran AE, Mussolino ME, O'Flaherty M, Pandey A, Perak AM, Rosamond WD, Roth GA, Sampson UKA, Satou GM, Schroeder EB, Shah SH, Spartano NL, Stokes A, Tirschwell DL, Tsao CW, Turakhia MP, VanWagner LB, Wilkins JT, Wong SS, Virani SS; American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics-2019 Update: a report from the American Heart Association. *Circulation.* 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659. Erratum in: *Circulation.* 2020 Jan 14;141(2):e33. PMID: 30700139.
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presenting to the emergency department with acute heart failure syndromes. *Ann Emerg Med.* 2007;49(5):627-669. doi:10.1016/j.annemergmed.2006.10.024. Epub 2007 Apr 3. Erratum in: *Ann Emerg Med.* 2010;55(1):16. PMID: 17408803.
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4. American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Acute Heart Failure Syndromes. Clinical Policy: Critical Issues in the Evaluation and Management of Adult Patients Presenting to the Emergency Department With Acute Heart Failure Syndromes: Approved by ACEP Board of Directors, June 23, 2022. *Ann Emerg Med.* 2022;80(4):e31-e59. doi:10.1016/j.annemergmed.2022.05.027. Erratum in: Ann Emerg Med. 2023 Mar;81(3):383. PMID: 36153055.

Note: Clinical Policy Alert synopses should be based upon organizational guidelines and policies relevant to emergency medicine. The guidelines themselves should be based on valid methodology. The recommendations in the guidelines should be written exactly as they are published by the organization. Charts showing recommendation criteria or methodology are important to include when possible.

Resources for Additional Learning:

The Pocus Atlas. POCUS for Undifferentiated Shortness of Breath. https://www.thepocusatlas.com/new-blog/2018/3/14/ddxof-pocus-for-undifferentiated-shortness-of-breath

POCUS 101. Lung Ultrasound Made Easy: Step-By-Step Guide. https://www.pocus101.com/lung-ultrasound-made-easy-step-by-step-guide/

Ottawa Heart Failure Risk Score (OHFRS). https://www.mdcalc.com/calc/3994/ottawa-heart-failure-risk-scale-ohfrs

Emergency Heart Failure Mortality Risk Grade (EHMRG). https://www.mdcalc.com/calc/1755/emergency-heart-failure-mortality-risk-grade-ehmrg

The STRATIFY Decision Tool. https://pubmed.ncbi.nlm.nih.gov/26449993/

Clinical findings and strength of recommendations regarding patient management were made according to the following criteria:

Level A recommendations

Generally accepted principles for patient care that reflect a high degree of clinical certainty (e.g., based on evidence from one or more Class of Evidence I or multiple Class of Evidence II studies).

Level B recommendations

Recommendations for patient care that may identify a particular strategy or range of strategies that reflect moderate clinical certainty (e.g., based on evidence from one or more Class of Evidence II studies or strong consensus of Class of Evidence III studies).

Level C recommendations

Recommendations for patient care that are based on evidence from Class of Evidence III studies or, in the absence of adequate published literature, based on expert consensus. In instances in which consensus recommendations are made, “consensus” is placed in parentheses at the end of the recommendation.

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KEY ADVANCES
CLINICAL POLICY ALERT

American Heart Association Focused Update on Pediatric Advanced Life Support, 2019, 2020

Reconfirmed May 2024

2019 American Heart Association Focused Update on Pediatric Advanced Life Support: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (1)

Pediatric Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency and Cardiovascular Care (2)

ABSTRACT: This 2020 focused update to the American Heart Association pediatric advanced life support guidelines follows the 2018 and 2019 systematic reviews performed by the Pediatric Life Support Task Force of the International Liaison Committee on Resuscitation. It aligns with the continuous evidence review process of the International Liaison Committee on Resuscitation, with updates published when the International Liaison Committee on Resuscitation completes a literature review based on new published evidence.

This update provides the evidence review and treatment recommendations for advanced airway management in pediatric cardiac arrest, modified respiratory rate during continuous cardiopulmonary resuscitation (CPR) with an advanced airway, prioritizes use of cuffed endotracheal tubes if an advanced airway is placed, early epinephrine use for patients with nonshockable rhythms, extracorporeal cardiopulmonary resuscitation in pediatric cardiac arrest, pediatric targeted temperature management during post–cardiac arrest care, and naloxone in cardiac arrest. The writing group analyzed the systematic reviews and the original research published for each of these topics.

Policy Recommendations and Focus Points in bold

Recommendation – Updated 2019; 2020

1. Best airway management in pediatric cardiac arrest?

   Patient Management Recommendations:

   Bag-mask ventilation is reasonable compared with advanced airway interventions (endotracheal intubation or supraglottic airway) in the management of children during cardiac arrest in the out-of-hospital cardiac arrest (OHCA) setting (Class 2a; Level of Evidence C-LD).

2. Best drug administration during cardiac arrest?

   Patient Management Recommendations:

   For pediatric patients in any setting, it is reasonable to administer the initial dose of epinephrine within 5 minutes from the start of chest compression. (Class 2a; Level of Evidence C-LD

   For shock refractory ventricular fibrillation/pulseless ventricular tachycardia, either amiodarone or lidocaine may be used. (Class 2b; Level of Evidence C-LD)

3. Extracorporeal cardiopulmonary resuscitation (ECPR) for in-hospital cardiac arrest (IHCA)?

   Patient Management Recommendations:

   ECPR may be considered for pediatric patients with cardiac diagnoses who have IHCA in settings with existing extracorporeal membrane oxygenation protocols, expertise, and equipment (Class 2b; Level of Evidence C-LD).

4. Best post-cardiac arrest targeted temperature management (TTM)?

   Patient Management Recommendations:

   Continuous measurement of core temperature during TTM is recommended (Class 1; Level of Evidence A).

   For infants and children between 24 hours and 18 years of age who remain comatose after OHCA or IHCA, it is reasonable to use either TTM 32°C to 34°C followed by TTM 36°C to 37.5°C or TTM 36°C to 37.5°C (Class 2a; Level of Evidence B-R).

5. Best post-cardiac arrest blood pressure management?

   Patient Management Recommendations:

   After return of spontaneous circulation, we recommend that parenteral fluids and/or vasoactive drugs be used to maintain a systolic blood pressure greater than the fifth percentile by age. (Class 1; Level of Evidence C-LD).

6. Should cuffed endotracheal tubes be used for intubation?

   Patient Management Recommendations:

   It is reasonable to choose cuffed ETTs over uncuffed ETTs for intubating infants and children. (Class 2a; Level of Evidence C-LD)

7. Should frequency of respirations increase if an advanced airway is placed during CPR?

   Patient Management Recommendation:

   When performing CPR in infants and children with an advanced airway, it may be reasonable to target a respiratory rate range of 1 breath every 2-3 seconds (20-30 breaths/min), accounting for age and clinical condition. Rates exceeding these recommendations may compromise hemodynamics. (Class 2b; Level of Evidence C-LD)

8. Should naloxone be given for opioid-related cardiac arrest?

   Patient Management Recommendations:

   For patients known or suspected to be in cardiac arrest, in the absence of a proven benefit from the use of naloxone, standard resuscitative measures should take priority over naloxone administration, with a focus on high-quality CPR (compressions plus ventilation).

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Resources for Additional Learning:

https://pubmed.ncbi.nlm.nih.gov/?term=pediatric+cardiac+arrest

https://rebelem.com/rebel-cast-ep75-2019-pals-update/

https://www.ahajournals.org/doi/epub/10.1161/CIR.0000000000000732

https://www.ahajournals.org/doi/epub/10.1161/CIR.0000000000000901

https://criticalcarenow.com/a-summary-of-the-pals-2020-updates/

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KEY ADVANCES
PRACTICE ADVANCE

Anticoagulant Reversal Strategies in the Emergency Department

Reconfirmed May 2024

Why is this topic important? Direct oral anticoagulants (DOACs) are used increasingly for various indications. Initially, these agents were approved for use without a corresponding strategy to stop serious bleeding in patients taking DOACs. Emerging data and policy guidelines are now available to reverse life-threatening or critical-site bleeding.

How will this change my clinical practice? Consensus guidelines promote standardized approaches to deciding which patients on DOACs with major bleeding are likely to benefit from reversal and when anticoagulation can be restarted after minor bleeding.

Synopsis Focus Points: All DOACs may be reversed with prothrombin complex concentrates (PCCs). Specific reversal agents are recommended if available.

Background:

DOACs are used to prevent and treat thromboembolic-associated events, such as stroke, venous thromboembolism, and pulmonary thromboembolism. Their main advantage over warfarin is that routine blood monitoring is not necessary. Bleeding is the most common complication, and specific laboratory tests are typically unavailable or unhelpful.

A multidisciplinary panel suggested anticoagulant reversal strategies in the emergency department (ED). (1) They identified three critical considerations for managing the bleeding patient taking an anticoagulant: 1) is this a life-threat? 2) is this a critical site for complications? and 3) what are the specifics of the agent, dose, and time taken?

Life-threatening bleeding is defined as a hemoglobin drop of ≥5 g/dL from previous, uncontrolled bleeding requiring procedural intervention, or hemodynamic instability. **Critical sites for bleeding** include airway, brain, pericardium, aorta, spine, eye, and closed space at risk for compartment syndrome.

Many patients have **major (serious) bleeding** rather than imminently life-threatening presentations. Major bleeding is defined as a hemoglobin drop of ≥2 g/dL from previous or one that requires a blood transfusion of ≥2 units of packed red blood cells. (2)

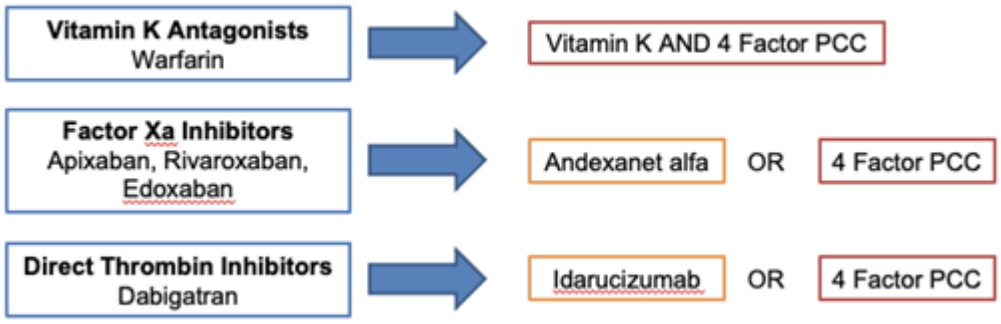
Life-threatening bleeding or critical site bleeding events should be treated with a reversal agent in addition to supportive measures and other potential therapeutic interventions (surgical, interventional radiology, or endoscopic). If the DOAC has an available reversal agent, it should be used as a first-line strategy. (1,2,4) Specific reversal agent examples are idarucizumab for dabigatran, and andexanet alfa for apixaban and rivaroxaban.

If these are not available or the patient does not know which DOAC they take, then **PCC** should be given. (1,2,4) Currently, only 4-factor PCC Kcentra is US Food and Drug Administration–approved for the reversal of major or life-threatening bleeding in patients taking warfarin. Kcentra is frequently used off-label for the reversal of DOACs. **Fresh frozen plasma** is an alternative to PCCs if unavailable, but it requires time to defrost (typically 2 hours), may involve large volumes to be administered, and has limited data to support its use for DOAC reversal.

Hemodynamically stable patients with major bleeding should have their agent held and the source of the bleeding addressed. Pressure should be applied if applicable and consideration should be given to a procedural intervention (i.e., interventional radiology or surgery) if appropriate. (2)

Minor bleeding (e.g., nose bleeds, bruising) may be monitored, the next dose held, and reassessment made as to restarting the medication. (3,4) Restarting the DOAC may be considered after a minor bleeding episode.

This is a strong recommendation based on consensus guidelines.



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https://www.acc.org/Tools-and-Practice-Support/Mobile-Resources/Features/ManageAnticoag
Kalantari A. Reversing NOACs – Updates for Emergency Physicians. Emergency Medicine Developments, Oddities, Curiosities (emDOCS). Accessed July 19, 2021. http://www.emdocs.net/reversing-noacs-updates-emergency-physicians/

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KEY ADVANCES
PRACTICE ADVANCE

Emergency Department Management of Recent-Onset Atrial Fibrillation with Rapid Ventricular Response

New July 2024

Why is this topic important? Atrial fibrillation (AF) is the most common sustained dysrhythmia managed in the emergency department (ED). Despite the frequency of ED visits, there are many areas of controversy concerning AF, with a paucity of data in some areas and differences in guideline recommendations.

How will this change my clinical practice? Recent literature, including guidelines, emphasize opportunities for rhythm control and anticoagulation in the acute management of recent-onset AF with rapid ventricular response (RVR). Evaluation for secondary causes of AF with RVR is paramount. Clinicians should consider rhythm or rate control in patients with primary AF with RVR, along with anticoagulation in appropriate patients. Standardizing assessment for rate control and an approach to anticoagulation may improve outcomes for patients with recent-onset AF during and after their ED visit.

Synopsis Focus Points:

1. **The management of ED patients with AF with RVR from a secondary source should focus on treating the acute illness rather than the AF. Aggressive rate or rhythm control in these patients is associated with poorer outcomes.**

2. **AF with RVR is a rare cause of cardiopulmonary instability; however, when encountered, patients with unstable AF should undergo direct current cardioversion (DCCV), ideally with a biphasic defibrillator at 200 J.**

3. **Stable patients with AF with RVR can be managed with a rhythm or rate control strategy based on patient preferences using shared decision making, although a rhythm control strategy may benefit patients without contraindications. Electrical or pharmacological**

cardioversion is appropriate for patients presenting within 12 hours of known onset of AF. Cardioversion is appropriate for low-risk patients presenting within 48 hours of known onset. All other patients, including those with unknown time of AF onset, prior stroke/transient ischemic attack, mitral valve disease, or mechanical heart valve, should undergo transesophageal echocardiogram (TEE) or three weeks of anticoagulation prior to cardioversion, with rate control the preferred strategy for these patients in the ED.

4. **For most patients, rate control can be achieved with either beta blockers (e.g., esmolol, metoprolol) or non-dihydropyridine calcium channel blockers (e.g., diltiazem, verapamil). Non-dihydropyridine calcium channel blockers are associated with decreased time to achieving rate control and overall greater reduction in rate. Patients with a known depressed ejection fraction EF (< 40%) or hypotension should be managed with amiodarone or digoxin for rate control.**

5. **Patients with AF and evidence of pre-excitation (e.g., Wolff-Parkinson-White) should not be treated with diltiazem or metoprolol. Instead, they should be treated with DCCV or procainamide.**

6. **Patients with recent-onset AF and a CHA2DS2-VASc score $\geq$ 2 for men and $\geq$ 3 for women without a contraindication should be started on anticoagulation, before cardioversion, if planned, and anticoagulation should be continued until outpatient cardiology follow-up or through the hospital admission if indicated.**

7. **Patients with secondary AF with RVR typically require admission. Appropriately selected patients with primary AF can be discharged on anticoagulation with cardiology follow-up if they are either cardioverted to sinus rhythm or heart rate is controlled (e.g., rate in the 100 beats/min range) in the ED.**

Background:

Primary versus secondary atrial fibrillation

AF is considered “primary” if it is from an established pathophysiological process or “secondary” if due to a reversible precipitant.(1,2) Secondary AF with RVR can be caused by a variety of conditions, including acute myocardial infarction (MI), acute pulmonary disease, alcohol withdrawal, hypovolemia, pulmonary embolism, sepsis, thyrotoxicosis, or toxic ingestion.(1-3) In patients with secondary AF, aggressive rate control or rhythm control is associated with patient harm, and the management of patients with secondary AF with RVR in the ED should focus on treating the acute illness, rather than providing rate or rhythm control.(1-3)

Assessment of a patient with newly diagnosed primary AF should include a 12-lead electrocardiogram (ECG) and laboratory tests, such as serum electrolytes, as well thyroid function tests and troponin based on the clinical scenario. A transthoracic echocardiogram (TTE) is recommended by guidelines, but the optimal timeframe for TTE remains to be defined.(1) For patients stabilized in the ED, TTE can occur in the inpatient or outpatient setting.

Atrial fibrillation with instability

Acute unstable AF with RVR, defined as AF causing hypotension (e.g., systolic blood pressure < 90 mm Hg or signs of shock), acute coronary syndrome (ongoing severe chest pain and ST segment changes on ECG, despite therapy), or pulmonary edema, should undergo synchronized DCCV at 200 J.(1-3) In patients requiring emergent DCCV without a contraindication, therapeutic anticoagulation should be initiated before cardioversion, or immediately after if it cannot be started prior, using low molecular weight heparin, unfractionated heparin, or a direct oral anticoagulant (DOAC).(1-3) Instability due to AF with RVR alone is rare, and secondary AF with RVR due to a precipitant should be considered.(1-3)

Rate versus rhythm for stable patients

ED patients with AF without signs of instability may be managed with either a rate or rhythm control strategy based on patient preferences using shared decision making. Recent literature suggests that rhythm control is effective and safe in appropriately selected patients and may be associated with reduced risk of cardiovascular death and ischemic event.(1-6) Current guidelines recommend that DCCV or pharmacologic cardioversion can be considered in hemodynamically stable patients with recent-onset AF at low risk of stroke.(1,2) DCCV is the preferred method for many patients, as it is > 90% effective, reduces ED length of stay, and is relatively safe.(1,2,5,6) Pharmacologic agents (e.g., procainamide or amiodarone) may be utilized, but they have an approximately 50% successful cardioversion rate.(1-3,6)

DCCV should be performed with procedural sedation using a biphasic machine at 200 J if possible with either anterior-lateral (AL) or anterior-posterior (AP) pad placement, avoiding direct placement over the sternum or large breast tissue.(1-3) Literature suggests AL and AP pad positioning to be equally effective when energy levels > 200 J are used.(7,8) However, if using lower energy levels (e.g., 100-150 J) with a biphasic defibrillator, AL pad positioning is likely more effective.(8) Approximately one-half of patients will not convert with the first DCCV attempt, and several attempts may be required.(8) For patients with extreme obesity, manual pressure augmentation may improve the success of cardioversion.(3)

Patients with AF and evidence of pre-excitation, including WPW (e.g., wide QRS or rates approaching 300 beats/min), should be treated with DCCV or procainamide. Treatment with rate control agents, including diltiazem or metoprolol is not recommended because these agents facilitate antegrade conduction via the accessary pathway and lead to ventricular fibrillation and cardiac arrest.(1-3)

Patients who present with AF with clear symptoms of < 48 hours have historically been considered to have a low risk of ischemic event after cardioversion.(1,3,9) However, recent literature focused on patients who underwent cardioversion for AF of < 48 hours found a significantly higher 30-day post-cardioversion rate of stroke in patients not anticoagulated.(1,2) Guidelines differ in their interpretation of these data. The American Heart Association (AHA) Guidelines (3) and the National Institute for Health and Care Excellence (NICE) guidelines from the United Kingdom (10) recommend that patients with AF of less than 48 hours duration can be cardioverted, except those with prior stroke/transient ischemic attack, moderate to severe mitral stenosis, or a mechanical heart valve. According to the AHA

guidelines, patients with a CHA2DS2-VASc score of ≥ 2 in men and ≥ 3 in women undergoing cardioversion should be anticoagulated as soon as possible prior to cardioversion, with long-term anticoagulation (3).

When a patient presents after 48 hours or with an uncertain onset of AF and a rhythm control strategy is necessary before three weeks of therapeutic anticoagulation, anticoagulation should be initiated, followed by TEE to exclude left atrial (LA) thrombi.(11)

Long-term anticoagulation

The decision to start long-term anticoagulation in the ED should be determined by a scoring system, such as CHA2DS2-VASc, using shared decision making with the patient regarding the risks and benefits (Table 1). The AHA guidelines state that for patients with AF and a CHA2DS2-VASc score of 0 in men or 1 in women, it is reasonable to omit long-term anticoagulation. For men with a CHA2DS2-VASc score of 1 and women with a score of 2, long-term anticoagulation can be considered based on patient preferences and risk factors. Patients with a CHA2DS2-VASc score of ≥ 2 in men and ≥ 3 in women should receive long-term anticoagulation, preferably with a DOAC (e.g., factor Xa inhibitor or direct thrombin inhibitor), or warfarin.(3)

For patients with AF for 48 hours duration or longer, or with unknown duration of AF, TEE or anticoagulation for at least three weeks is recommended before cardioversion, regardless of the CHA2DS2-VASc score or the method (electrical or pharmacological) of cardioversion.(2-4) Eligible patients with AF not associated with mechanical heart valves or moderate to severe mitral stenosis should be started on oral anticoagulation in the ED with apixaban, dabigatran, edoxaban, or rivaroxaban.(1-3) When choosing an oral anticoagulant, apixaban and rivaroxaban are the most common agents used in the ED. Recent literature suggests apixaban may be associated with lower rates of hemorrhage compared to other anticoagulants.(12)

Table 1. CHA2DS2-VASc score

CHA2DS2-VASc Score

Score Factors	Points
Age	
• <65	0
• 65-74	+1
• ≥75	+2
Sex	
• Male	0
• Female	+1
History of CHF	+1
History of hypertension	+1
History of stroke/TIA/thromboembolism	+2
History of vascular disease	+1
History of diabetes	+1

Lip GY, Nieuwlaat R, Pisters R, Lane DA, Crijns HJ. Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the euro heart survey on atrial fibrillation. Chest. 2010 Feb;137(2):263-72. doi: 10.1378/chest.09-1584.

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Abbreviations
CHF: Congestive heart failure TIA: Transient ischemic attack

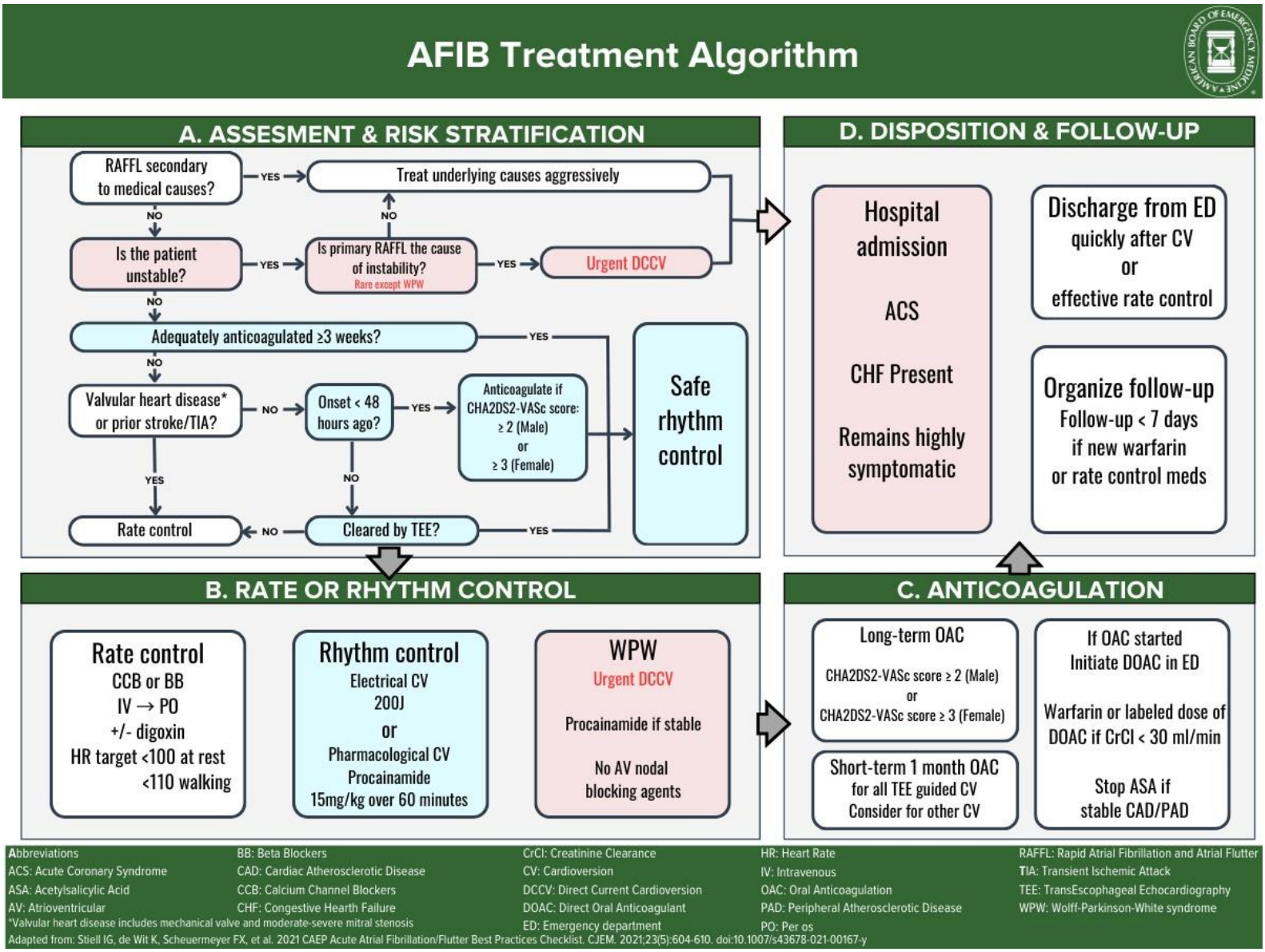
Rate control

Patients who are not eligible for a rhythm control strategy should be managed with rate control. Beta blockers or non-dihydropyridine calcium channel blockers (e.g., diltiazem or verapamil) may be used as first-line agents for rate control in patients without significant left ventricle (LV) dysfunction.(1-3) Both classes are effective, and if the patient is already taking a calcium channel blocker or beta blocker, a medication from that drug class should be used first.(2) If the patient is not taking one of these agents, literature suggests diltiazem is more effective and is associated with decreased time to achieving rate control and total decrease in ventricular rate compared to metoprolol.(13,14) Intravenous (IV) diltiazem or metoprolol may be given up to three times in the first hour, with an oral dose administered within 30 minutes of achieving rate control.(2) Guidelines recommend avoiding these medications in patients with acute decompensated heart failure, hypotension, or significant LV dysfunction and instead recommend amiodarone or digoxin.(1-3,15) The target for rate control is a resting heart rate of < 100 beats/min or < 110 beats/min if walking.(1,2)

Disposition

Many patients with AF can be safely discharged home after acute management with either rate control or rhythm control, but clinicians must consider several factors.(16) Current risk stratification tools demonstrate a modest ability to predict adverse events in those with AF.(16) Patients at low risk for adverse events include those who have achieved rate or rhythm control, are able to comply with discharge instructions and medications (e.g., anticoagulants), and have follow-up. They should have no severe concurrent diseases (sepsis), severe comorbidities (decompensated heart failure), secondary AF, or evidence of a complication (hypotension). Hospitalization is often required for patients with AF due to another medical illness, highly symptomatic patients, or those in whom rate or rhythm control cannot be achieved.(1-3)

Figure 1. Atrial Fibrillation (AFIB) Treatment Algorithm



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Resources for Additional Learning

Atrial Fibrillation/Flutter Best Practice Checklist. https://emottawablog.com/2022/04/atrial-fibrillation-flutter-best-practice-checklist/

Emergency Medicine Cases – Atrial Fibrillation. https://emergencymedicinecases.com/episode-20-atrial-fibrillation/

Unstable Atrial Fibrillation – ED Management. https://first10em.com/atrial-fibrillation/

SGEM: Rhythm is Gonna Get You – Into an Atrial Fibrillation Pathway. https://thesgem.com/2018/06/sgem222-rhythm-is-gonna-get-you-into-an-atrial-fibrillation-pathway/

SGEM: AFIB of the Night – Chemical Vs. Electrical Fist Cardioversion. https://thesgem.com/2019/09/sgem267-afib-of-the-night-chemical-vs-electrical-first-cardioversion/

CHA2DS Score Calculator. https://www.mdcalc.com/calc/801/cha2ds2-vasc-score-atrial-fibrillation-stroke-risk

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KEY ADVANCES
PRACTICE ADVANCE

Noninvasive Respiratory Support for Acute Hypoxemic Respiratory Failure

Updated May 2024

Why is this topic important? Acute respiratory failure is common in adults presenting to the emergency department (ED). An ideal means of respiratory support is noninvasive, reduces the rate of intubation, and improves mortality.

How will this change my clinical practice? Studies comparing nasal high-flow (NHF) systems with noninvasive positive pressure ventilation (NIPPV) have not proven a consistent difference in mortality or need for intubation among patients with acute hypoxemic or hypercapnic respiratory failure. Based on available literature, NHF systems have a role in appropriately selected patients.

Synopsis Focus Points:

- **NHF provides heated, humidified gas and a set fraction of inspired oxygen and flow and can reduce dead space and potentially work of breathing.**
- **NHF or NIPPV is a reasonable option for first-line noninvasive respiratory support in patients with acute hypoxemic respiratory failure. NHF is also an option in those with acute chronic obstructive pulmonary exacerbation or acute decompensated heart failure.**
- **NHF should be started at higher flow rates to reduce lung strain and work of breathing. Weaning the patient once improved is recommended, rather than titrating from low to high, if the patient worsens.**
- **Close monitoring of any patient on noninvasive respiratory support is necessary. Unsuccessful noninvasive respiratory support is associated with increased mortality. Patients who fail to improve likely require endotracheal intubation.**

Background:

Acute respiratory failure has a variety of etiologies and requires emergent management. Several modalities may assist with airway and respiratory support, known as noninvasive respiratory support (NRS). NRS can be divided into NIPPV, which is based on pressure, and NHF systems, which are based on flow. NIPPV has been shown to be effective at preventing intubation and improving outcomes in patients with acute hypercapnic or hypercapnic and hypoxemic respiratory failure, specifically exacerbations of chronic obstructive pulmonary disease (COPD), asthma, and acute decompensated heart failure (ADHF), but its use is controversial when respiratory failure is secondary to other etiologies, including acute lung injury or infection.

NHF systems provide humidified and heated gas at a set fraction of inspired oxygen (FiO_2) and a set flow of air (often at 30-70 L/min). This can improve mucociliary clearance, gas exchange, and oxygenation while reducing work of breathing.(1-4) Due to these effects, there are several potential uses for NHF, particularly those with acute hypoxemic respiratory failure (AHRF).

Indications:

Acute hypoxemic respiratory failure
AHRF is associated with parenchymal airspace disease from inflammation or infection. NHF has several advantages in AHRF, as it can support oxygenation and ventilation with flow-dependent effects while avoiding excess pressure.(3,4) A seminal randomized controlled trial (RCT) published in 2015 that compared NHF, NIPPV, and standard oxygen in AHRF found greater risk of death at 90 days in those receiving standard oxygen (hazard ratio HR = 2.01; 95% CI 1.01 to 3.99) or NIPPV (HR = 2.50; 95% CI 1.31 to 4.78) versus NHF systems, although there was no difference in rates of intubation.(5) While subsequent studies conducted in patients with COVID-19 have demonstrated conflicting results,(6,7) a meta-analysis comparing face mask NIPPV and NHF found no difference in mortality or intubation.(8) Although it is currently unclear whether a certain subset of patients with AHRF would benefit more from either NHF or NIPPV, the 2021 Surviving Sepsis Campaign guidelines recommended use of NHF over other NIPPV modalities.(9) NHF may also assist in those with pneumonia or hemoptysis who demonstrate hypoxemia or increased work of breathing, as NHF allows for clearance of any secretions.

COPD, Asthma, and Hypercapnic Respiratory Failure
In patients with COPD or asthma exacerbation, airway collapse may result in air trapping, hyperinflation, and increased work of breathing.(4) NIPPV can reduce inspiratory and expiratory effort and work of breathing in these patients and is currently considered the standard of care for those with COPD exacerbation.(10) However, NHF may also assist, as it may flush the airway dead space and increase end-expiratory lung volumes, ultimately reducing inspiratory effort and the work of breathing.(11,12) A meta-analysis comparing NIPPV and NHF in those with acute COPD exacerbation found no difference in mortality or rates of treatment failure,(11) and a multicenter trial found NHF was noninferior to NIPPV in reducing partial pressure of carbon dioxide ($PaCO_2$) at 2 hours.(12) A subgroup analysis found $PaCO_2$, pH, intubation rates, and treatment failure rates were similar between NHF and NIPPV in patients with hypercapnia,(13) and another study found NHF reduced $PaCO_2$ in hypercapnic patients with pneumonia and COPD.(14)

While it has been hypothesized that NHF does not provide enough ventilatory support to be as useful as NIPPV in hypercapnic respiratory failure, a meta-analysis of 8 RCTs (N = 528) found no difference between NHF and NIPPV, with NHF demonstrating a relative risk of 0.86 (95% CI 0.48 to 1.56) for mortality and 0.80 (95% CI 0.46 to 1.39) for intubation compared to NIPPV.(11)

Importantly, guidelines recommend NIPPV for patients with COPD exacerbation, hypercapnia, and respiratory acidosis.(15) If the undifferentiated patient in the ED has increased work of breathing but does not have severe respiratory acidosis, NHF may be considered. While NHF can be considered in patients with significant work of breathing and respiratory acidemia, NIPPV may be necessary, targeting a higher inspiratory positive airway pressure and lower expiratory positive airway pressure.

Decompensated heart failure
ADHF is associated with elevated pulmonary venous pressures resulting in pulmonary edema, hypoxemia, and increased work of breathing. NIPPV has traditionally been used in this setting and is associated with reduced need for intubation, work of breathing, and mortality.(4) NHF has also been used to treat ADHF, and recent studies suggest NHF is a viable option for managing ADHF.(16,17) NHF can increase end-expiratory lung volumes, which may improve lung mechanics and gas exchange in those with ADHF.

Using NHF:

When using NHF, it is recommended to start with higher flows to assist with oxygenation and work of breathing and wean as the patient improves. This contrasts with titrating up the flow as the patient worsens. NRS success reduces work of breathing and mortality, but NRS failure is associated with increased mortality.(18-20) Therefore, frequent patient reassessment is necessary, no matter which NRS modality is used. Studies have sought to predict NRS failure. The ROX index ([SpO2/FiO2] / respiratory rate) has demonstrated promise, with values > 4.88 predictive of not requiring intubation, and values < 2.85 at 2 hours, < 3.47 at 6 hours, and < 3.85 at 12 hours predict NHF failure.(21) Patients with multiorgan failure are also more likely to fail NRS. If the patient's respiratory status fails to improve with NRS, endotracheal intubation is recommended.

This is level 1a evidence.(22)

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Resources for additional learning:

https://emcrit.org/pulmcrit/pulmcrit-does-the-high-trial-debunk-high-flow-nasal-cannula/

https://emcrit.org/ibcc/support/

https://emcrit.org/pulmcrit/bipap-hfnc/

https://www.thesgem.com/2015/11/sgem135-the-answer-my-friend-is-blowin-in-your-nose-high-flow-nasal-oxygen/

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KEY ADVANCES
SUGGESTION FROM THE LITERATURE

Demystifying Lactate in the Emergency Department

Updated May 2024

Why is this topic important? Lactate is commonly used in the emergency department as a marker of resuscitation, to identify patients with occult hypoperfusion, and to provide prognostic information. Although lactate can be a useful tool when interpreted correctly, improper interpretation can mislead clinicians and result in inappropriate care and unnecessary therapies.

How will this change my clinical practice? Although lactate is commonly assumed to be a waste product that accumulates during times of hypoperfusion, leading to anaerobic metabolism, the role and production of lactate are more complex.

Focus Point:
An elevated lactate does not always equate to tissue hypoperfusion and is associated with many conditions. Clinicians should determine whether the elevated lactate seems to be related to hypoperfusion, such as shock, arrest, or ischemic limb. If so, resuscitation should proceed while monitoring lactate levels for clearance. A repeat lactate is essential to know whether clearance is occurring. Alternative causes of hyperlactatemia, such as medications, liver failure, or carbon monoxide toxicity, should be sought.

Background:
Despite a commonly held belief that elevated lactate levels in sepsis occur as a consequence of anaerobic metabolism from tissue malperfusion, evidence indicates that this may not be the primary source of lactate, particularly in patients without overt shock. (1) Lactate was previously assumed to be a waste product, but more recent studies have shown that lactate is actually an important metabolic substrate for energy production and oxidation/reduction reactions. (2) In fact, accelerated aerobic glycolysis from adrenergic stress is thought to be a significant cause of hyperlactatemia in sepsis, with additional contributions from impaired clearance, medication effects, microcirculatory dysfunction, and tissue malperfusion.

The correlation between hypotension and lactate production is weak. However, elevated

lactate levels and an inability to clear lactate are associated with a worse prognosis in many conditions, particularly sepsis, trauma, hemorrhage, shock, and cardiac arrest, even for patients without overt signs of shock. (3-5)

As such, when faced with a patient with hyperlactatemia, the emergency medicine physician should determine whether other signs of shock or hypoperfusion are present. (1) If so, the patient should be resuscitated as indicated. Repeat lactate levels are essential to monitor clearance. (6) If evidence of shock or hypoperfusion are not present, providing resuscitation, such as large volumes of intravenous (IV) fluids, will not necessarily improve outcomes, especially if elevated lactate is due to medications that affect mitochondrial function, such as metformin, or toxins, such as carbon monoxide and cyanide.

This is level 5 evidence. (7)

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Resources for Additional Learning:

https://emcrit.org/pulmcrit/understanding-lactate-in-sepsis-using-it-to-our-advantage/

https://rebelem.com/andromeda-shock-peripheral-perfusion-vs-serum-lactate-in-septic-shock/

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KEY ADVANCES
PRACTICE ADVANCE

Avoiding Routine Use of Supplemental Oxygen for Patients with Suspected Acute Myocardial Infarction

Updated May 2024

Why is this topic important? Routine administration of supplemental oxygen to patients with suspected acute myocardial infarction (AMI) has been a mainstay of treatment for decades. Recent research has demonstrated that this practice does not provide benefit for patients with suspected AMI who are not hypoxic, but also does not likely result in harm.

How will this change my clinical practice? The routine emergency department management of the patient with suspected AMI does not require supplemental oxygen unless their oxygen saturation is <90% or the patient is in respiratory distress.

Synopsis Focus Points: Emergency physicians are strongly recommended to not routinely administer supplemental oxygen to patients with suspected AMI unless hypoxic or in respiratory distress.

Background:
A 2016 Cochrane Review reported no difference in hospital all-cause mortality based on four trials that compared supplemental oxygen with ambient air in patients with AMI; however, due to study limitations, these conclusions were based on a very low certainty of evidence. (1) In 2017, a registry-based randomized trial (DETO2X) was published, which enrolled 6,629 normoxic (room air oxygen saturation ≥90%) patients with suspected AMI. The results were reported as an intention-to-treat analysis and demonstrated that routine supplemental oxygen at 6 L/min for 6 to 12 hours did not lower all-cause mortality (the primary outcome), cardiovascular mortality, or hospitalization for heart failure within 1 year compared with those receiving ambient air (all-cause mortality rate 5% vs 5.1%, respectively). (2,3) Subsequent meta-analyses that included the large DETO2X trial also reported a lack of mortality benefit of supplemental oxygen for normoxic patients. (4-6)

One interpretation of this evidence is that supplemental oxygen in suspected AMI is ineffective but safe, which may be untrue. Hyperoxia may cause harm by increasing coronary artery

vasoconstriction and vascular resistance, along with the potential myocardial injury related to free radicals. (1,4-6) However, a small trial that randomized 95 normoxic patients with ST-elevation MI (STEMI) undergoing acute percutaneous coronary intervention (PCI) to supplemental oxygen or air did not show any effect on the size of ischemia before PCI or on infarct size with follow-up cardiac magnetic resonance. The authors concluded that these findings support the safety of withholding supplemental oxygen in normoxic patients with STEMI. (7) Based on the current evidence, the routine use of supplemental oxygen in those with AMI is not recommended.

This is Level 1a evidence. (8)

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Resources for Additional Learning:

https://pubmed.ncbi.nlm.nih.gov/?term=oxygen%20myocardial%20infarction

https://rebelem.com/?s=oxygen+myocardial+infarction

https://www.youtube.com/watch?v=Kps3VzbykFQ

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KEY ADVANCES
PRACTICE ADVANCE

Pediatric Status Epilepticus Management (for children > one month of age)

New July 2024

Why is this topic important? Convulsive status epilepticus is a common neurological emergency in childhood that is associated with significant economic burden, morbidity, and mortality.(1) Management guidelines that highlight the importance of rapid assessment, stabilization, and treatment aim to reduce the associated morbidity and mortality. Unfortunately, therapies are often delayed or underdosed (2,3,4) and poor adherence to the recommended guidelines leads to worse outcomes.(5)

How will this change my clinical practice? An expedited, stepwise approach to the management of pediatric status epilepticus using appropriately dosed therapies is critical to optimizing clinical outcomes in children.

Synopsis Focus Points:
For pediatric status epilepticus, defined as seizure activity > five minutes and/or ongoing seizure on presentation to Emergency Medical Services (EMS)/Emergency Department (ED) or one seizure without full recovery, **following a stepwise process that starts with the administration of benzodiazepines via IV/IM/IO/IN as first-line therapy will help lead to early cessation of seizure activity and reduction of poor outcomes.**

Background:
Management guidelines for the treatment of status epilepticus in children exist to assist in the delivery of critical therapies in a timely fashion to avoid the potential adverse sequela of continued seizure activity.(2) Resolving the seizure activity as soon as possible is important because they become increasingly difficult to stop as they continue, thus increasing the risk for morbidity and mortality. Current guidelines recommend stepwise antiseizure medication administration with up to two doses of benzodiazepines being delivered within the first five to ten minutes of seizure onset, followed by additional antiepileptic medications if required.

While benzodiazepines are well known to be the first-line therapy for status epilepticus, there is evidence that they are often underdosed in the EMS and ED settings regardless of drug, route of

administration, or patient weight.(4) It is known that adherence to the recommended guidelines is correlated with improved clinical outcomes. Unfortunately, there are often several challenges and barriers that are encountered to administering appropriate dosages of medications, including lack of intravenous access. While the intravenous route may be preferred, delays in administration of the benzodiazepine are important to avoid, so the intramuscular or intranasal route should also be considered early.

Selection of second-line therapies may generate uncertainty in providers, but the current evidence clearly demonstrates that the recommended options are all safe and effective.(6,7,8) There is no statistical significance found among levetiracetam, fosphenytoin, and sodium valproate when cessation of seizure activity in children is compared. Given their similar efficacies, levetiracetam is often preferred due to its favorable safety, side-effect profile, medication interactions, and ease of administration.

A representation of the current recommendations for the management of pediatric status epilepticus (for patients > one month of age) follows:

0–5 minutes:

- Initial assessment includes airway, breathing, circulation (ABCs), cardiopulmonary monitoring, and finger-stick glucose.
- Consider investigation of potential causes of provoked seizures (e.g., trauma, infection, electrolyte derangements, sub-therapeutic antiepileptic prescriptions, and intoxicants). This should not delay therapies.

5-15 minutes:

- Give appropriate dose of benzodiazepine promptly.
    - **If no IV/IO access**, then give **midazolam 0.2 mg/kg/dose IM/Intranasal** (max 10 mg)
        - May consider standardized IM/IN doses based on weight: 5 mg/dose for 13-40 kg; 10 mg/dose for > 40 kg.
    - **If IV/IO access**, then:
        - **Midazolam 0.2 mg/kg/dose IV/IO** (max 10 mg/dose) *OR*
        - **Lorazepam 0.1 mg/kg/dose IV/IO** (max 4 mg/dose)
- A second dose of benzodiazepine may be given if seizure activity continues five minutes after the first dose was given.

>15 minutes:

- Second-line antiepileptic medication should be given if seizure activity continued after benzodiazepine administration.
- **All second-line antiepileptic medications have similar efficacy** for pediatric status epilepticus.
- Levetiracetam has a favorable side-effect profile and may be given rapidly.
    - **Levetiracetam 60 mg/kg/dose** (max 4,500 mg/dose)
    - **Valproic acid 40 mg/kg/dose** (max 3,000 mg/dose)
        - Rate of 1.5-3 mg/kg/min, max 20 mg/min
    - **Fosphenytoin 20 mg phenytoin equivalents/kg/dose** (max 1,500 mgPE/dose)
        - Rate of 2 mgPE/kg/min, max 150 mgPE/min
    - **Phenytoin 20 mg/kg/dose** (max 1,500 mg/dose)
        - Rate of 1-3 mg/kg/min, max 50 mg/min

- **Phenobarbital 20 mg/kg/dose** (max 1,000 mg/dose)
  - Rate of 1mg/kg/min, max 30 mg/min
- Continued seizure activity or concern for nonconvulsive status epilepticus should lead to use of a third-line agent.
- Third-line agents and dosing:
  - **Midazolam**:
    - Loading dose 0.2 mg/kg IV at 2 mg/minute;
    - Infusion at 0.05-2 mg/kg/hour
  - **Propofol**:
    - Loading dose 1-2 mg/kg IV, administered over 1-2 min;
    - Infusion at 30-200 mcg/kg/minute
  - **Phenobarbital:**
    - Loading dose 20 mg/kg IV; rate 1mg/kg/min, max 30 mg/min
    - Maintenance dose of 5 mg/kg IV given at 12 and 24 hours
  - **Ketamine**:
    - Loading dose 0.5 mg/kg given over 60 seconds, may repeat every 3-5 minutes up to 3 mg/kg;
    - Infusion of 0.1-0.5 mg/kg/hr

- **Airway protection should be considered as risk for apnea increases with use of additional sedating medications.**

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Notes: Practice Advance synopses should be built from a strong body of evidence, that likely includes a systematic review. The synopsis will include a recommendation that should be similar in wording to how GRADE recommendations are given. These should not be controversial recommendations and essentially all emergency physicians should be adopting them. The impact or “effect size” should be substantial and no significant harm should be associated with this gain.

Resources for Additional Learning:

EMS for Children innovation and Improvement Center Pediatric Education and Advocacy Toolkit. https://emscimprovement.center/education-and-resources/peak/peak-status-epilepticus/trekk-eiic-pediatric-status-epilepticus-practice-guideline/

PedEM Morsels: Non-Convulsive Status Epilepticus. https://pedemmorsels.com/non-convulsive-status-epilepticus-in-children/

EMRA: Management of Pediatric Seizures. https://www.emra.org/emresident/article/pediatric-seizure/

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KEY ADVANCES
PRACTICE ADVANCE

Adult Procedural Sedation in the Emergency Department

New July 2024

Why is this topic important? Procedural sedation (PS) is often needed in the emergency department (ED) when analgesia or anxiolysis alone is not adequate to perform necessary procedures. It is a critically important component of comprehensive emergency care and a required core competency for emergency physicians.

How will this change my practice? PS can be associated with both minor and catastrophic adverse outcomes. Knowing the evidence, best practices, and provider responsibilities when performing PS will assure emergency physicians provide the highest quality and safest patient care.

Synopsis Focus Points:

1. **PS is a critically important component of comprehensive emergency care and a required core competency for emergency physicians, including rescue airway interventions, sedation agent selection, and support and monitoring of patient cardiovascular and respiratory status.(1,2)**
2. **Alternative options to PS should be considered when feasible and appropriate (e.g., hematoma blocks and regional nerve blocks) to reduce risks of adverse events.(3)**
3. **While it is well established that emergency physicians can perform all levels (i.e., moderate, deep, and dissociative) of PS in the ED, targeting one versus another does not reliably result in the intended level of sedation.(1,4)**
4. **Nothing by mouth (NPO) status has not been shown to reduce the risk of adverse events.(1,2,3)**
5. **Commonly used agents for PS in adult emergency departments include, but are not limited to: opioids, benzodiazepines, barbiturates, ketamine, propofol, remifentanil, alfentanil, dexmedetomidine, etomidate, and nitrous oxide. (See Table 1.)**
6. **No agent, alone or in combination, can be uniformly recommended over another due to safety or efficacy profiles. Emergency providers should weigh relative needs for analgesia,**

sedation, and potential risks and benefits when developing an individual patient's sedation plan.(1,2)

7. **Adverse events are rare when performing PS in the emergency department. Vomiting, hypoxia, and hypotension are the most common.(5) See Table 2.**

Background:

American College of Emergency Physicians Policy Statement on Procedural Sedation in the Emergency Department (2023) recommendations (1):

- Emergency physicians who have received the appropriate training and skills necessary to safely provide procedural sedation, such as board certification (ABEM/ABOEM) in emergency medicine or graduates of an ACGME-accredited emergency medicine program, should be credentialed without additional requirements for procedural sedation.
- The decision to provide sedation and the selection of the specific pharmacologic agents should be individualized for each patient by the emergency physician and should not be otherwise restricted.
- Emergency physicians and staff are expected to be familiar with the pharmaceutical agents they use and be prepared to manage their potential complications.
- To minimize complications, the appropriate drugs and dosages must be chosen and administered in an appropriately monitored setting. Patient evaluation should be performed before, during, and after their use.
- Institutional and departmental guidelines related to the sedation of patients should include the selection and preparation of patients, informed consent, equipment and monitoring requirements, hospital staff training and competency verification, criteria for discharge, and continuous quality improvement.
- ED physician and nursing leadership should have ongoing collaboration to develop institutional policy regarding nursing roles in sedation and the ability of nurses to administer sedatives. Emergency nurses with demonstrated competencies are qualified and capable to safely administer propofol, ketamine, and other sedatives.

The Royal College of Emergency Medicine Best Practice Guideline on Procedural Sedation in the Emergency Department (2022) recommendations (2):

- Every emergency department should have a sedation lead responsible for ensuring the appropriate governance structures are in place in relation to procedural sedation.
- Emergency departments undertaking paediatric procedural sedation should have a nominated paediatric sedation lead and specific paediatric guidelines.
- The use of a sedation proforma (e.g., template, checklist, process) or similar electronic equivalent is strongly recommended.
- Processes should be in place for adverse incident reporting arising from procedural sedation as well as rapid investigation of significant events.
- Emergency departments should have clear policies with regards to competencies for the provision of procedural sedation in both adults and children as well as up-to-date lists of those clinicians fulfilling the competencies.

- Simulation training sessions should be used to promote safe and effective procedural sedation in line with local policies.
- Procedural sedation should take place in a designated area of the emergency department with the requisite staffing levels and equipment (e.g., resuscitation room).
- Procedural sedation should not take place without careful consideration of the analgesic requirement for the procedure, taking into account any analgesics already administered.
- The clinician who will be responsible for providing the procedural sedation should undertake a pre-procedure Safety Brief with the other members of the team.
- The use of oxygen during procedural sedation is encouraged especially for at risk patient groups (e.g., ischemic heart disease) and those undergoing deep sedation procedures (increased risk of short periods of apnea).
- Monitoring during procedural sedation should include: three lead ECG, oxygen saturations, continuous capnography, and non-invasive blood pressure.
- The use of a patient advice leaflet (i.e., written patient educational information) is encouraged.

American College of Emergency Physicians Clinical Policy on Procedural Sedation and Analgesia in the Emergency Department (2014) recommendations (3):

- Do not delay procedural sedation in adults or pediatrics in the ED based on fasting time. Preprocedural fasting for any duration has not demonstrated a reduction in the risk of emesis or aspiration when administering procedural sedation and analgesia. (**Level B recommendation**)
- Capnography* may be used as an adjunct to pulse oximetry and clinical assessment to detect hypoventilation and apnea earlier than pulse oximetry and/or clinical assessment alone in patients undergoing procedural sedation and analgesia in the ED. *Capnography includes all forms of quantitative exhaled carbon dioxide analysis. (**Level B recommendation)**
- During procedural sedation and analgesia, a nurse or other qualified individual should be present for continuous monitoring of the patient, in addition to the provider performing the procedure. Physicians who are working or consulting in the ED should coordinate procedures requiring procedural sedation and analgesia with the ED staff. (**Level C recommendation)**
- Ketamine can be safely administered to children for procedural sedation and analgesia in the ED. Propofol can be safely administered to children and adults for procedural sedation and analgesia in the ED. (**Level A recommendation**)
- Etomidate can be safely administered to adults for procedural sedation and analgesia in the ED. A combination of propofol and ketamine can be safely administered to children and adults for procedural sedation and analgesia. (**Level B recommendation**)
- Ketamine can be safely administered to adults for procedural sedation and analgesia in the ED. Alfentanil can be safely administered to adults for procedural sedation and analgesia in the ED. Etomidate can be safely administered to children for procedural sedation and analgesia in the ED. (**Level C recommendation**)

Table 1. Common Agents for PS in the ED (6)

Agent	Starting Dosage, Adult and Pediatric Patients	Onset (min)	Duration (min)	Advantages	Disadvantages
Fentanyl	1 mcg/kg IV	1-2	30-40	•Rapid onset •Short duration •Minimal Cardiovascular effects	•Chest wall rigidity (when given rapidly in large doses) •Analgesic properties only
Remifentanil	0.05-0.1 mcg/kg/ min IV infusion with supplemental 0.5-1 mcg/kg IV boluses	< 1-3	3-10	•Short duration •Can be titrated	•Respiratory depression •Analgesic properties only
Midazolam	0.05-0.1 mg/kg IV	1.5	60-120	•Rapid onset •Short duration •Multiple routes	•Respiratory depression •Moderate duration •Sedative properties only
Nitrous Oxide	30%-70% concentration	1-2	3-5	•Rapid onset •Minimal CV effects	•Emesis •Expansion of gas-filled structures
Propofol	0.5-1 mg/kg IV	< 1	3-10	•Rapid onset •Antiemetic •Short duration	•Hypotension •Respiratory depression •Injection pain •Sedative properties only
Ketamine	•1-1.5 mg/kg IV •4-5 mg/kg IM	~1 (IV) ~5 (IM)	10-15 (IV) 15-30 (IM)	•Preserved airway reflexes •Predictable •Provides analgesia and sedation	•Emergence phenomena •Emesis •Laryngospasm •Hypertension •Tachycardia •Increased secretions
Ketofol Ketamine + propofol	0.5 mg/kg ketamine IV and 0.5 mg/kg propofol IV administered simultaneously	1-3	10-15	•Airway preservation •Hemodynamic stability •Rapid recovery •Use together offsets hemodynamic effects of each individual agent •Provides analgesia and sedation	Same as for each individual

Table 1. Common Agents for PS in the ED (6)

Agent	Starting Dosage, Adult and Pediatric Patients	Onset (min)	Duration (min)	Advantages	Disadvantages
Etomidate	0.15 mg/kg IV	< 1	5-10	•Rapid onset •Minimal CV effects	•Respiratory depression •Myoclonus •Sedative properties only

Table 2. Adverse Event for PS in the ED (5)

Adverse Event	Studies	Overall Incidence (Per 1,000 Sedations)	Meds with Highest Rate of Adverse Event
Agitation	33 Studies / 6,631 Sedations	9.8 (95% CI 6.1-13.5)	Ketamine Ketamine / Propofol
Apnea	22 Studies / 3,264 Sedations	12.4 (95% CI 7.9-233.5)	Midazolam Midazolam / Opiate
Aspiration	10 Studies / 2,370 Sedations	1.2 (95% CI 0-2.6)	
Bradycardia	5 Studies / 837 Sedations	6.5 (95% CI 1.1-11.8)	Etomidate Midazolam / Opiate
Hypotension	27 Studies / 5,801 Sedations	15.2 (95% CI 10.7-19.7)	Propofol Midazolam / Opiate
Hypoxia	42 Studies / 7,116 Sedations	40.2 (95% CI 32.5-47.9)	Propofol Midazolam / Opiate
Intubation	19 Studies / 3,636 Sedations	1.6 (95% CI 0.3-2.8)	---
Laryngospasm	5 Studies / 883 Sedations	4.3 (95% CI 0-8.5)	---
Vomiting	25 Studies / 3,319 Sedations	16.4 (95% CI 9.7-23.0)	Ketamine

Adapted from Rebel EM, Bellolio et al.[5]

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Resources for Additional Learning:

ACEP Policy Statement: Unscheduled Procedural Sedation: A Multidisciplinary Consensus Practice Guideline

Procedural sedation in adults: Medication selection, dosing, and discharge criteria - UpToDate

Clinical Practice Guideline for Emergency Department Procedural Sedation With Propofol: 2018 Update (acep.org)

Procedural Sedation Guide: A Reference for Your ID Badge (aliem.com)

Procedural Sedation - WikEM

Complications of Procedural Sedation - REBEL EM - Emergency Medicine Blog

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KEY ADVANCES
PRACTICE ADVANCE

Procedural Sedation for Children in the Emergency Department

New July 2024

Why is this topic important? Children who require care in our emergency departments (EDs) across the country often require interventions to mitigate their anxiety and pain. Fortunately, this can often be done with simple strategies like using developmentally appropriate attention-focusing techniques or even oral or intranasal analgesic or anxiolytic medications. There are situations, however, in which a greater degree of pain and anxiety control is required. Procedural sedation (PS) is appropriate to help provide optimal care for children when these situations are encountered and is commonly performed safely in EDs. There are several options for medications to perform PS, with variable benefits and adverse event rates. Despite the frequency of PS in children, there is still a relative paucity of high-quality data to guide best practices.

How will this change my clinical practice?
The development of protocols to guide the best practices for pediatric PS can ensure that PS be performed safely and effectively in the ED. This Practice Advance Synopsis can assist in the development of these local and regional protocols.

Synopsis Focus Points:

1. **Pediatric PS in the ED is generally safe**, with clinically important adverse events being uncommon. The most common severe respiratory complication is laryngospasm (approximately 1/250 sedations), which occurs almost exclusively with ketamine or ketamine/propofol. Vomiting is the most common minor adverse event, occurring in 5-6% of cases.
2. **There is no perfect medication to use for PS for all children in all scenarios**. Several safe and effective options are available and include propofol, ketamine, ketamine-propofol combination, etomidate, midazolam, dexmedetomidine, and nitrous oxide. Clinicians may choose medications based on availability of the options, their experience with individual medications, as well as patient-specific factors. There is no evidence that one of these agents is consistently superior to others.
3. **Ketamine-propofol combination is a reasonable option** for pediatric PS, but has not shown consistent superiority over other options, particularly propofol alone.
4. **Capnography may allow earlier detection of hypoventilation** during PS but has not been shown to decrease meaningful adverse events.

5. **Pre-sedation ondansetron has not consistently been shown to reduce post-sedation vomiting**.

Background:

Safety and adverse events: A systematic review of almost 14,000 pediatric sedations performed in the ED since 2004 showed a low rate of serious adverse events.(1) Aspiration and need for intubation were extremely rare (< 0.05% or 1/2000). Laryngospasm occurred in approximately 0.4% or 1/250, and almost exclusively with the use of ketamine, with or without concurrent propofol. The most common minor adverse event was vomiting (approximately 5.6%), which was most frequent with ketamine. The next most common adverse events were agitation (1.8% total and most frequent with midazolam); hypoxia (1.5% overall and most frequent with etomidate); and apnea (0.7% overall and most frequent with ketamine-propofol combination). **Overall, these data point to the safety of pediatric PS performed in the ED when performed by experienced emergency physicians with adequate resources.**

Medication Choice: There are several common medications used for pediatric PS in the ED. Each may have its own set of advantages and risks compared to others. Recently, a large meta-analysis including 23 pediatric studies and seven studies that had both adults and children demonstrated several medication options that had favorable outcomes compared to midazolam-opioids.(2) Sedation recovery time is shorter with propofol, patient satisfaction is better with ketamine-propofol combination, and respiratory adverse events are less common with ketamine alone. The selection of medication should take into consideration the potential risk for adverse events, as each medication has its own specific risk profile. Each of the most common adverse events in the systematic review by Bellolio et al had a different agent associated with the highest frequency of that event.(1) Several smaller randomized studies comparing efficacy and adverse events between several of these different agents, however, have yielded inconsistent results.(3-6) The sedation plan must also account for what is available to the individual providers, as some agents, such as nitrous oxide and dexmedetomidine, may not be widely available for PS in the ED setting. Any of the aforementioned options may be reasonable choices for pediatric PS in the ED. Of note, the 2014 ACEP Clinical Policy for Procedural Sedation and Analgesia states that **ketamine and propofol can be safely administered to children for PS in the ED (Level A recommendation). The combination of ketamine and propofol receives a Level B recommendation, while etomidate receives a Level C recommendation.**(7)

Ketofol or ketamine-propofol combinations: Ketamine-propofol combination offers several theoretical advantages over single agent ketamine or propofol, as the unwanted effects of each medication may offset each other. Ketamine may minimize the potential for apnea or hypotension with larger doses of propofol alone, for example. The combination of the two drugs should also allow for smaller doses of each medication, potentially allowing for shorter recovery time. Trials comparing the combination of ketamine and propofol to other agents, however, have not consistently confirmed a clinically meaningful advantage.(3,4,8) A 2020 systematic review (11 trials comprising 1274 patients) found no difference between the combination of ketamine and propofol and the solo agents with respect to development of apnea, desaturation, vomiting, satisfaction, or any other adverse events. There was, however, an approximately 10-minute shorter time to recovery with the ketamine-propofol combination.(8) **The combination of ketamine and propofol is a reasonable option for pediatric PS in the ED, but likely offers little to no meaningful advantage over ketamine or propofol alone.**

Capnography: During PS, the most common potentially serious adverse events are related to ventilation and oxygenation. Capnography allows for earlier detection of apnea and may allow the

treating clinician to intervene or alter the sedation earlier, which theoretically decreases the risk of eventual hypoxia, need for more aggressive interventions, or even intubation. Evidence from randomized trials that demonstrate a clinically important benefit is, however, lacking in both adults and children. A 2017 Cochrane review comprising only three ED trials concluded “There is a lack of convincing evidence that the addition of capnography to standard monitoring in ED PSA [procedural sedation and analgesia] reduces the rate of clinically significant adverse events.”(9) Of the three included trials, one was in children, and did not demonstrate a difference in desaturations or respiratory interventions between the capnography and control groups.(10) **Capnography may allow for earlier detection of apnea and hypoventilation and, given the low potential for harm, should be encouraged where available, but is not mandatory to perform safe pediatric PS in the ED**.

Ondansetron: At least four randomized trials have been performed to evaluate the efficacy of pre-sedation ondansetron to prevent post-sedation vomiting in children.(11-14) In three trials, the sedation agent was intramuscular or intravenous ketamine,(12-14) and in the fourth, the agents were fentanyl and nitrous oxide.(11) There was no effect in the nitrous oxide study or the largest, open-label (n = 237) ketamine study.(11,12) Two smaller, double-blind, ketamine studies (n = 111 and 127) found a decrease in post-sedation vomiting with ondansetron administration (9% vs 22% in one study and 5% vs 13% in the other).(13,14) Given the inconsistent results, **we conclude ondansetron pre-treatment is reasonable for ketamine sedations, but likely of only modest benefit at most.**

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Notes: Practice Advance synopses should be built from a strong body of evidence, that likely includes a systematic review. The synopsis will include a recommendation that should be similar in wording to how GRADE recommendations are given. These should not be controversial recommendations and essentially all emergency physicians should be adopting them. The impact or “effect size” should be substantial and no significant harm should be associated with this gain.

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KEY ADVANCES
CLINICAL POLICY ALERT

Outpatient Treatment for Pulmonary Embolism

Reconfirmed May 2024

Based primarily on 2021 Guideline Update on Antithrombotic Therapy for Venous Thromboembolism (VTE) Disease
Stevens SM, Woller SC, Kreuziger LB, Bounameaux H, Doerschug K, Geersing GJ, Huisman MV, Kearon C, King CS, Knighton AJ, Lake E, Murin S, Vintch JRE, Wells PS, Moores LK. Antithrombotic therapy for VTE disease: second update of the CHEST Guideline and Expert Panel Report. Chest. 2021;160(6):e545-e608. doi:10.1016/j.chest.2021.07.055. PMID: 34352278. Erratum in: Chest. 2022;162(1):269. (1)

Policy Recommendations and Focus Points in bold

Clinical Question: In patients with low-risk pulmonary embolism (PE), is outpatient treatment recommended?

Patient Management Recommendation:

In patients with low-risk PE, we recommend outpatient treatment over hospitalization provided access to medications, ability to access outpatient care, and home circumstances are adequate (strong recommendation, low-certainty evidence). (1)

Key Points:

- Treatment at home is more convenient and less expensive than hospitalization and is preferred by most patients. (1)
- Treatment with direct oral anticoagulants (DOACs) (e.g., apixaban or rivaroxaban) makes outpatient therapy more accessible and less complicated. (1)
- To help identify low-risk patients suitable for home treatment, physicians may use clinical decision instruments, such as the Hestia criteria, or clinician judgment in conjunction with a simplified Pulmonary Embolism Severity Index (sPESI). (1,2)

- Patients with evidence of right ventricular (RV) strain or increased troponin/B-type natriuretic peptide (BNP) levels should be considered for hospitalization, given their higher risk for poor outcomes. (1) RV strain pattern on electrocardiogram (ECG), RV abnormality on computed tomography (CT), or elevated troponin/BNP should prompt a diagnostic echocardiogram.
- Although the evidence base supporting the guideline recommendations is considered weak, it is consistent with the results of 2 recent systematic reviews that reported no difference in outcomes among patients with low-risk PE, whether treated as inpatients or outpatients. (1,3,4)

Patient Risk Stratification

The initial disposition of patients with PE should be guided by an assessment of clinical patient risk. Risk stratification can be accomplished by classifying patients into the following three categories (5):

- High-risk: signs of shock, end-organ damage or hypoperfusion, hypotension, or cardiac arrest
- Intermediate-risk: evidence of right-heart strain on imaging (ECG, CT, echocardiogram), elevated troponin, and/or elevated BNP
- Low-risk: clinically stable without evidence of high-risk or intermediate-risk features *and* low-risk assessment using a clinical decision tool, such as the Hestia criteria or sPESI score + physician judgment (see diagram)

Patients with high- or intermediate-risk criteria should be hospitalized for inpatient treatment.

In the HOME-PE trial by Roy et al., a randomized study comparing the Hestia criteria with the sPESI, both strategies had similar safety and effectiveness, allowing more than one third of patients to be treated safely at home. Importantly, both scoring tools were considered complementary to the physician's clinical judgment. The treating physician was able to overrule the triaging tool in cases when admission was prudent for medical or social reasons.(2) The MATH-VTE trial conducted by Kline et al. demonstrated real-world efficacy and safety of monotherapy oral anticoagulation to treat patients with deep vein thrombosis and PE in the emergency care setting who are deemed low risk by either the modified Hestia criteria or sPESI plus clinical judgment. In this study, eligible patients with a variety of PE locations (including subsegmental, segmental, lobar, and main pulmonary artery) were treated successfully as outpatients. In addition, the 30-day rate of PE and VTE recurrence was low (1.0%), the rate of subsequent bleeding complications requiring hospitalization was 0.8%, and, importantly, there were no deaths. (6) These studies support the ability of these clinical decision tools to safely risk stratify patients to outpatient DOAC therapy.

If the patient has no high- or intermediate-risk criteria, evaluate the patient for low risk using Hestia criteria or clinician judgment plus sPESI:

Criteria for low-risk (adapted from Kline J, Adler D, Alanis N, et al. Study protocol for a multicentre implementation trial of monotherapy anticoagulation to expedite home treatment of patients diagnosed with venous thromboembolism in the emergency department. BMJ Open 2020;10[10]:e038078). (7)

The modified Hestia criteria (all must be true):

- Systolic blood pressure >100 mm Hg
- No thrombolysis needed
- No active bleeding
- SaO_2 >94% while breathing room air
- Not already anticoagulated
- No more than two doses of intravenous narcotics in the emergency department
- No other medical or social reasons to admit
- Creatinine clearance >30 mL/min
- Not pregnant, no severe liver disease or heparin-induced thrombocytopenia

OR

Physician judgment plus sPESI criteria
The physician opinion that a patient's overall social and medical situation is favorable for home treatment* and the patient has a zero score on the sPESI.

All of the following must be true:

- Age 18–81 years
- No history of cancer
- No history of heart failure or chronic lung disease
- Pulse <110 beats/min
- Systolic blood pressure >99 mm Hg
- O_2 saturation >89%

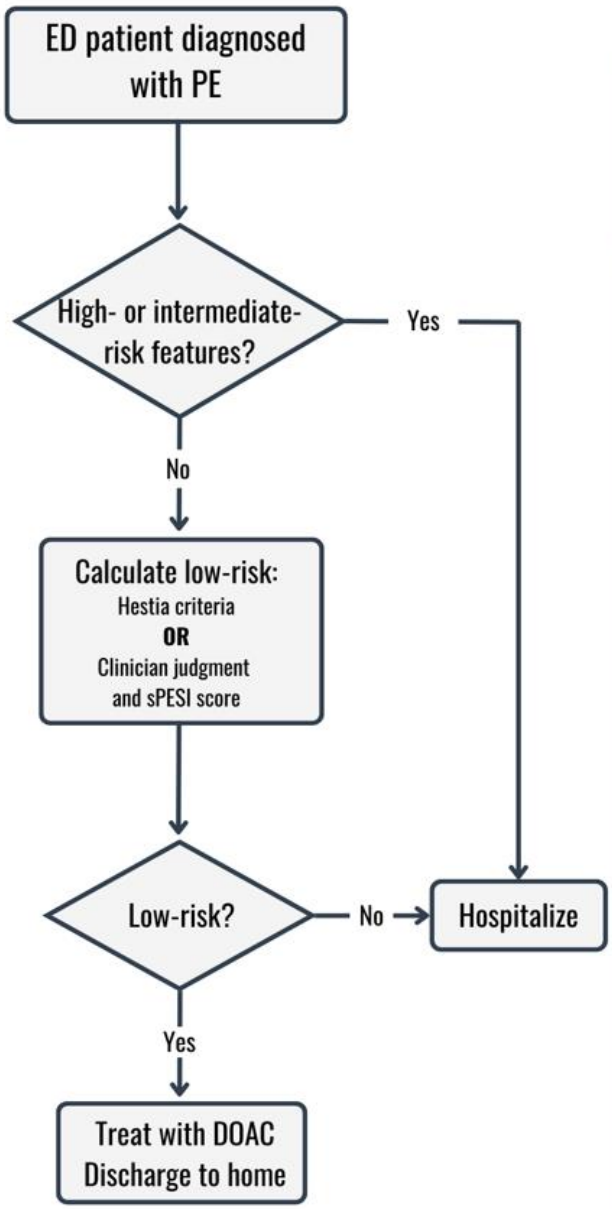
*Examples of additional social and medical factors include: Does the patient have the ability to obtain (i.e., pay for) medication? Does the patient have access to expeditious outpatient follow-up? Does the patient have adequate home circumstances (family and social support)?

Disposition Determination

Recent guidelines recommend that patients classified as low-risk PE can be started on a DOAC and managed at home. The expert panelists placed "a very high value on avoiding the potential increase in risk of harm (including much greater cost) related to hospitalization even though the magnitude of benefit is similar." (1)

Patients who are classified as low risk by Hestia criteria or clinician judgment and sPESI score, have access to DOAC medication and outpatient follow-up, and have appropriate social support can be discharged home with outpatient therapy.

PE Treatment Algorithm



Risk Stratification

High-risk: Signs of shock, end-organ damage or hypoperfusion, hypotension, or cardiac arrest.

Intermediate-risk: Evidence of right-heart strain on imaging (ECG, CT, echocardiogram), elevated troponin, and/or elevated BNP.

Low-risk:

Modified Hestia criteria (all must be true):

- Systolic blood pressure > 100 mm Hg
- No thrombolysis needed
- No active bleeding
- SaO_2 > 94% on room air
- Not already anticoagulated
- No more than two doses of intravenous narcotics in the emergency department
- No other medical or social reasons to admit
- Creatinine clearance > 30 mL/min
- Not pregnant, no severe liver disease or heparin-induced thrombocytopenia

OR

Physician judgement plus sPESI criteria

The physician opinion that a patient's overall social and medical situation is favorable for home treatment* and the patient has a zero score on the sPESI.

All of the following must be true:

- Age 18-81 years
- No history of cancer
- No history of heart failure or chronic lung disease
- Pulse <110 beats/min
- Systolic blood pressure > 99 mm Hg
- O_2 saturation > 89%

Examples of additional social and medical factors include: Does the patient have the ability to obtain (i.e pay for) medication? Does the patient have access to expeditious outpatient follow-up? Does the patient have adequate home circumstances (family and social support)?

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Resources for Additional Learning:

Link to full guideline: https://journal.chestnet.org/article/S0012-3692(21)01506-3/fulltext

Pulmonary Embolism Severity Index (PESI): https://www.mdcalc.com/calc/1304/pulmonary-embolism-severity-index-pesi

https://thesgem.com/2021/03/sgem323-momma-im-comin-home-for-outpatient-treatment-of-a-pulmonary-embolism/

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KEY ADVANCES
PRACTICE ADVANCE

Acute Stroke Syndrome Evaluation and Management

Updated May 2024

Why is this topic important? Over the past decade, studies have demonstrated that select patients with acute ischemic stroke (AIS) due to a large vessel occlusion (LVO) with salvageable brain tissue may have profound benefit from endovascular reperfusion therapy with mechanical thrombectomy (MT) up to 24 hours from their time of being last known well (LKW.) (1-4)

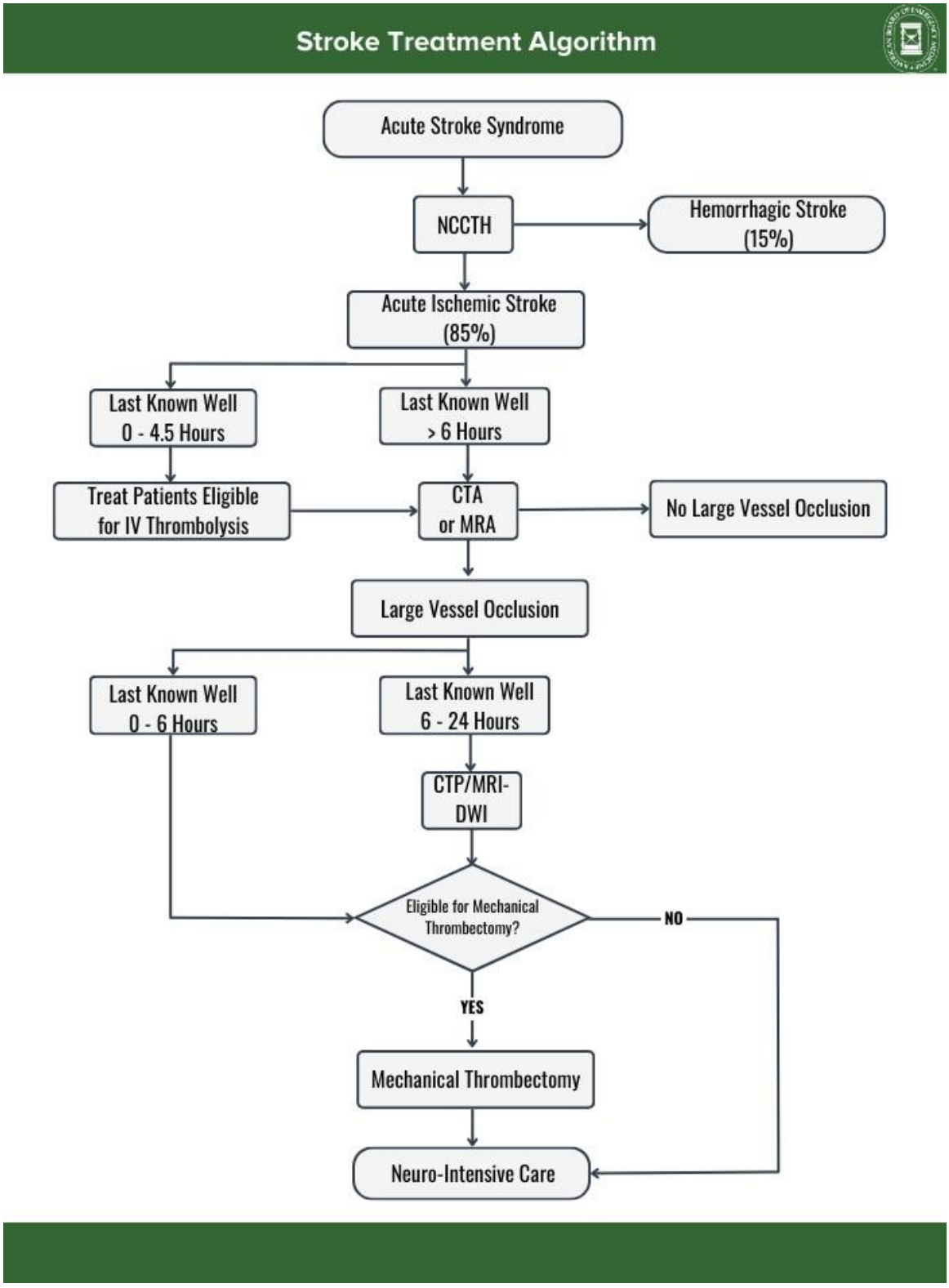
How will this change my clinical practice? Emergency physicians play a critical role in the rapid identification of acute stroke syndromes, where the timely initiation of imaging, consultation, and intervention can dramatically impact outcomes. This includes the rapid assessment of clinical criteria and the ordering of appropriate advanced imaging to facilitate timely MT when indicated. When MT is not available on-site, rapid transportation to a comprehensive stroke center should be prioritized when known to be beneficial. (1)

Synopsis Focus Points:

- Emergency physicians should evaluate every patient with an AIS (< 24 hours since last LMK) as a potential candidate for MT.
- Patients most likely to benefit from MT include those with:
  - a National Institutes of Health Stroke Scale (NIHSS) score > 6
  - an anterior circulation LVO with salvageable brain tissue on advanced imaging, and
  - functional independence at baseline (e.g., modified Rankin Scale [mRS] score 0-2).
- Patients eligible for intravenous (IV) thrombolysis therapy should still be considered eligible for MT.
- Patients identified as candidates for MT should be appropriately transferred to a comprehensive stroke center if MT cannot be performed on-site.

Background:
The American Heart Association Stroke Council 2019 update to their AIS guidelines to include strong recommendations (Class I) based on high-quality evidence (Level A) that are directly relevant to the ED selection of patients with suspected AIS that may be candidates for MT.(1) In appropriately selected patients with AIS due to LVO and salvageable brain tissue, MT should be incorporated into a comprehensive stroke evaluation and management algorithms up to 24 hours from their time of being LKW. (See Figure B)

Figure B. Algorithm for Acute Stroke Syndrome Evaluation



Legend: NCCTH, noncontrast computed tomography of the head; IV, intravenous; CTA, computed tomography angiogram; MRA, magnetic resonance angiogram; CTP, computed tomography perfusion; MRI-DWI, magnetic resonance imaging with diffusion-weighted imaging.

Imaging Modalities:

Non-Contrast Computed Tomography (CT) of the Head (NCCTH):

- NCCTH should be obtained as quickly as feasible to exclude hemorrhagic stroke and other potential stroke mimics.
- NCCTH is also used to calculate an Albert Stroke Program Early Computed Tomography Score (ASPECTS) to quantify early ischemic changes on NCCTH and predict the extent of final stroke in patients with emergent LVO. (5)
    - A lower ASPECTS confers a greater likelihood of poor function outcome. An ASPECTS of 0-4 suggests poor functional outcomes, while a score of ≥ 6 has been shown to optimally benefit from MT.

CT Angiography (CTA) or Magnetic Resonance Angiography (MRA):

- CTA/MRA should be obtained as quickly as feasible to identify any vascular abnormalities or a proximal anterior circulation LVO, potentially treatable with MT.
    - Proximal anterior circulation LVO includes occlusion of the internal carotid artery or the M1 and M2 segments of the middle cerebral artery.

CT Perfusion (CTP) or MR Diffusion-Weighted Imaging (MR-DWI):

- CTP/MR-DWI should be obtained as quickly as feasible to identify ongoing core infarct-to-perfusion mismatch after 6 hours from LKW.
    - The “core mismatch” concept is a surrogate marker for the presence of a relevant volume of salvageable brain tissue and refers to a significant lesion volume difference (i.e., mismatch) between the perfusion deficit and the ischemic core. (6,7)

Therapeutic Interventions:

Intravenous (IV) Thrombolysis:

- IV thrombolysis has been shown to have an absolute harm reduction of 5-10% (Number needed to treat [NNT] 10-19) in appropriately selected patients with AIS up to 4.5 hours after symptom onset.
- Both alteplase and tenecteplase have been shown to be beneficial (8)
- Administration of IV thrombolysis should not preclude the ability to use MT as a therapeutic intervention BUT should not delay MT either. (9,10)

Mechanical Thrombectomy (MT):

- MT has been shown to have an absolute harm reduction of 39%, with a NNT of 2.8 when used in appropriately selected patients with AIS patients with anterior circulation LVO. (11)
- Rapid treatment is important, as the benefit from MT falls by 5.3% for every hour of delay. The percentage that can be expected to be independent declines from 50% for thrombectomy within 3 hours to 45% at 4.5 hours, to 40% at 6 hours, and to 33% at 8 hours. (12)
- The decision to pursue MT should be made in conjunction with a neuro-interventionalist or stroke team.
- Patients identified as candidates for MT should be appropriately transferred to a comprehensive stroke center if MT cannot be performed on-site.

- *MT Eligibility Criteria*:
  - For patients within 6 hours of symptom onset or LKW: (1)
    - Pre-symptom mRS ≤ 1
    - NIHSS score of ≥ 6**
    - Causative LVO of the internal carotid artery or middle cerebral artery segment 1
    - ASPECTS of ≥ 6
  - For patients 6-24 hours out from symptom onset or LKW:
    - DAWN Criteria for 6-24 hours (13)
      - Pre-symptom mRS ≤ 1
      - NIHSS score ≥ 10**
      - No evidence of intracerebral hemorrhage on CT or MR imaging
      - No evidence of infarct involving > ⅓ middle cerebral artery territory
      - A core mismatch favorable to MT
    - DEFUSE-3 Criteria for 6-16 hours (14)
      - Pre-symptom mRS ≤ 2
      - NIHSS score ≥ 6**
      - ASPECTS ≥ 6
      - A core mismatch favorable to MT

Table. Mechanical Thrombectomy Eligibility Criteria

	Criteria		
	American Heart Association[1]	DEFUSE-3[14]	DAWN[13]
LKW	< 6 hrs	6 to 16 hrs	6 to 24 hrs
Baseline mRS	≤ 1	≤ 2	≤ 1
NIHSS**	≥ 6	≥ 6	≥ 10
ASPECTS	≥ 6	≥ 6	N/A
Infarct Characteristics	LVO of Internal Carotid Artery or M1	LVO with a core mismatch favorable to MT	LVO involving < 1/3 Middle Cerebral Artery territory; No Intracerebral Hemorrhage

** The Society of Neurointerventional Surgery Guidelines state “Thrombectomy may be considered in patients with anterior circulation AIS and NIHSS < 6 when associated with disabling symptoms (class IIa, level B-NR)." [15]

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Resources for Additional Learning:

NIHSS Stroke Scale/Score Calculator: https://www.mdcalc.com/nih-stroke-scale-score-nihss

Modified Rankin Scale for Disability Calculator: https://www.mdcalc.com/modified-rankin-scale-neurologic-disability

Alberta Stroke Program Early CT Score (ASPECTS): https://www.mdcalc.com/calc/3164/alberta-stroke-program-early-ct-score-aspects

Mendelson SJ, Prabhakaran S. Diagnosis and management of transient ischemic attack and acute ischemic stroke: a review. JAMA. 2021;325(11):1088-1098. doi:10.1001/jama.2020.26867. PMID: 33724327.

ED Stroke Management in the Age of Endovascular Therapy. Emergency Medicine Cases. https://emergencymedicinecases.com/ed-stroke-management-endovascular-therapy/

With or Without You – Endovascular Treatment With or Without TPA for Large Vessel Occlusions. The Skeptics' Guide to EM. http://thesgem.com/2020/05/sgem292-with-or-without-you-endovascular-treatment-with-or-without-tpa-for-large-vessel-occlusions/

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KEY ADVANCES
SUGGESTION FROM THE LITERATURE

Video-Assisted Intubation for Adult Patients in the Emergency Department

Reconfirmed May 2024

Why is this topic important? Endotracheal intubation (ETI) is a common and critically important procedure performed by emergency physicians. Recently, video laryngoscopy (VL) has become widely available as an alternative option to direct laryngoscopy (DL). Based on low-to-moderate certainty evidence, the authors of a Cochrane review concluded that VL may increase ETI success and decrease hypoxic events and esophageal intubation compared with DL in adults undergoing any ETI. (1) Subsequently published data further support these findings.

How will this change my clinical practice? Emergency physicians should have VL available, and those who have not attained proficiency with it need to master this essential skill.

Focus Points:

1. **VL should be considered as a first-line option for ETI, especially in patients with known or predicted difficult airway.**

2. **VL and DL are different techniques requiring different skill sets. Mastery of both is imperative for emergency physicians. Because mastery of one technique does not equate to mastery of the other, continuing lifelong training and experience with both techniques is crucial.**

Background:

A Cochrane review of 222 studies including more than 21,000 adults found that VL may increase ETI success and first-pass success and improve glottic view, while decreasing esophageal intubation and hypoxemic events, compared with DL. (1) The increase in ETI success was more pronounced in patients with known or predicted difficult airway.

Importantly for emergency physicians to know, most patients included in these studies were undergoing planned ETI in the operating room (OR). These were not emergent ETIs. In the subgroup of ETIs performed outside of the OR setting (11 studies including 1,846 cases), there was no statistically significant difference in the rate of successful intubation (relative risk for failed ETI with VL = 0.68, 95% CI = 0.42-1.09). The Cochrane review did not assess other outcomes for this subgroup.

Previous systematic reviews of studies outside the OR have reported lower rates of esophageal intubation with VL, but there was little evidence for improvement in other outcomes, such as hypoxemia, ETI success, or first-pass success. (2-4)

Two contributions to the literature since the Cochrane review warrant special attention. The first is data from the National Emergency Airways Registry. Analysis of this observational database of thousands of emergency intubations and other observational studies indicates an association between VL and higher first-pass intubation success compared with DL. (5,6). Second, the 2023 DEVICE study randomized 1,417 emergency department or intensive care unit adult patients to VL versus DL. (7) Almost all intubations were performed by trainees with a median of 50 prior intubations and more VL than DL experience. The trial was stopped early after an interim analysis found significantly higher first-pass success with VL than DL (85% versus 71%). There were no differences in adverse events or clinical outcomes.

Endotracheal intubation can be accomplished successfully using VL or DL. VL may increase first-pass ETI success compared with DL, especially in patients with known or predicted difficult airways. Because VL and DL are different techniques, emergency physicians need to learn and maintain mastery with DL in order to be prepared for instances of VL failure, which do occur, most frequently in cases when blood, vomit, or other substances in the airway obscure video views, as well as power or technical failure of the VL devices.

This is level 1 evidence. (8)

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Resources for Additional Learning:

https://litfl.com/video-laryngoscopy/

https://rebelem.com/video-laryngoscopy-direct-laryngoscopy-trainees/

https://thesgem.com/2014/05/sgem75-video-killed-direct-laryngoscopy/

https://www.theairwaysite.com/

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