# Hemodynamic Instability: Common Complications and Conditions

MCG Health
Inpatient & Surgical Care
30th Edition

**CCC: CCC-019 (ISC)**
**Link to Codes**



## Prevention

- Prevention issues and possible preventive measures include[A](1)(2)(3)(4)(5):
  - For hypovolemia: monitoring and early treatment of fluid depletion(6)
  - For cardiogenic shock(2)(7)(8)(9):
    - Early revascularization in acute MI patient to limit ischemia(9)(10)(11)
    - Urgent valve repair or replacement, or intra-aortic balloon pump for acute severe mitral regurgitation or other valvulopathies(9)(12)(13)
    - Urgent surgical repair of severe valve insufficiency or ventricular septal rupture after MI(14)(15)
    - Evaluation for cardiopulmonary abnormalities, particularly congenital heart disease, and anticipation of preoperative, intraoperative, and postoperative needs (eg, type of anesthesia, positioning for procedures, oxygenation, need for vasopressors or inotropes)(16)
  - For obstructive shock(3):
    - Urgent relief of restriction of cardiac chambers (eg, relief of pericardial tamponade, tension pneumothorax, scarring)
    - Urgent relief of outflow restriction (eg, mediastinal masses, coarctation of aorta)
  - For distributive shock (eg, sepsis, anaphylaxis)(17)(18)(19)(20):
    - Preventive measures to avoid hospital-acquired infections and resultant septic shock (eg, aseptic catheter insertion and antiseptic maintenance, removal of unnecessary central and urinary catheters, aspiration precautions, ventilator care bundles)(21)(22)(23)(24)(25)(26)(27)
    - Primary prophylaxis (eg, colony-stimulating factors, antibiotics) for high-risk patient(28)
    - Early and appropriate treatment of hospital-acquired infections to prevent septic shock(29)
    - Preoperative vaccination for respiratory pathogens (eg, influenza, pneumococcal, respiratory syncytial virus, COVID-19) in accordance with Centers for Disease Control and Prevention (CDC) guidelines(26)
    - Avoidance of known allergens and early treatment of allergic reactions to prevent anaphylaxis and anaphylactoid reactions(30)(31)

- Pretreatment with antihistamines and corticosteroids, or desensitization if allergen use is unavoidable (eg, anesthetic or IV contrast agent) in susceptible patient(31)
- Ensure adequate fluid balance preoperatively and use fluid loading or vasoconstrictors if hypotension occurs with anesthesia.[B](32)
- Use of leukoreduced product in patient at high risk of transfusion reaction
- Use of rapid response teams for patient with acute abnormal vital signs(1)

# Clinical Indications for Ongoing Inpatient Care

- Ongoing inpatient care is indicated for **1 or more** of the following(1)(2)(3)(4)(5)(17)(18)(19)(30)(33)(34)(35):
  - Hypotension that is new or symptomatic[C](4)(37)
  - Symptomatic Tachycardia or Bradycardia unresponsive to treatment (eg, analgesia, fluids)(3)
  - Inadequate perfusion, as indicated by **1 or more** of the following:
    - Lactate of 2.0 mmol/L (18 mg/dL) or more secondary to hypotension (ie, hypoperfusion)[D](2)(20)(33)(34)
    - Metabolic acidosis (arterial or venous[E] pH less than 7.35) not otherwise explained(2)
  - Orthostatic vital sign changes[F] that are symptomatic and unresponsive to treatment (eg, fluids)(47)(48)
  - IV inotropic medication or vasopressor medication required(3)(33)
  - Mechanical circulatory support required(33)

# Alternatives to Inpatient Care

- Alternatives to inpatient stay extension include:
  - Not usually used

# Discharge

- Extended stay beyond goal length of stay for primary condition may be needed until **ALL** of the following are present(2)(4)(5)(19)(20)(49):
  - Heart rate greater than 60 and less than 100 beats per minute or acceptable for next level of care
  - SBP greater than 100 mm Hg and less than 160 mm Hg or acceptable for next level of care
  - DBP greater than 50 mm Hg and less than 100 mm Hg or acceptable for next level of care
  - Oxygen saturation at baseline or acceptable for next level of care
  - Orthostatic vital sign changes absent, at baseline, or acceptable for next level of care[F]
  - Medical comorbidities manageable at lower level of care(50)

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# Footnotes

[A] Causes of hemodynamic instability can be categorized into hypovolemia, cardiogenic shock, extracardiac obstruction, or distributive hemodynamic instability from profound peripheral vasodilatation.(1)(2)(3) [ A in Context Link 1 ]

[B] The efficacy of pretreatment with fluid loading to avoid anesthesia-induced hypotension is controversial.(32) [ B in Context Link 1 ]

[C] A retrospective analysis of over 500 million emergency department patients found that a modified shock index (ie, heart rate divided by mean arterial blood pressure) greater than 1.7 is associated with a 5-fold higher likelihood of in-hospital mortality.(36) [ C in Context Link 1 ]

[D] There are numerous causes of an elevated lactate level. The most common are cardiogenic or hypovolemic shock, severe heart failure, severe trauma, or sepsis. However, there are also other etiologies to consider, such as vigorous exercise, seizures, liver disease, or medication use (eg, metformin, beta2-agonists); therefore, interpretation of elevated lactate levels requires consideration of the clinical context (eg, well-appearing post exercise vs hypotensive). The severity and persistence of the elevation can sometimes be helpful in this differentiation. In most instances of lactic acidosis, blood pH is less than 7.35, with a serum bicarbonate level of 20 mEq/L (mmol/L) or lower. However, a coexisting respiratory or metabolic alkalosis can mask these findings.(34)(38)(39)(40)(41) [ D in Context Link 1 ]

[E] Analyses have concluded that venous and arterial pH measurements are highly correlated, with small differences between them that are usually not clinically significant.(42)(43)(44)(45)(46) If a mixed acid-base disorder is suspected, an ABG is indicated.(43) [ E in Context Link 1 ]

[F] Orthostatic vital sign changes include an SBP fall of 20 mm Hg or more, a DBP fall of 10 mm Hg or more, or a decrease in SBP to less than 90 mm Hg within 3 minutes of standing.(47) [ F in Context Link 1, 2 ]

# Definitions

## Bradycardia

- Bradycardia[A], as indicated by **1 or more** of the following(1)(2)(3):
  - Heart rate less than 50 beats per minute in adult (age 18 years or older)[B]
  - Heart rate less than 55 beats per minute in adolescent 13 to 17 years of age
  - Heart rate less than 60 beats per minute in child or adolescent 6 to 12 years of age

- Heart rate less than 65 beats per minute in child 3 to 5 years of age
- Heart rate less than 70 beats per minute in child 1 to 2 years of age
- Heart rate less than 80 beats per minute in infant 6 to 11 months of age
- Heart rate less than 90 beats per minute in infant 3 to 5 months of age

### References


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### Footnotes

A. Criteria based upon clinician-acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

B. An evidence-based specialty society guideline has defined bradycardia in adults as less than 50 beats per minute.(1)

## Hypotension

- Hypotension, as indicated by **1 or more** of the following:
  - Hypotension in adult patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure less than 90 mm Hg[A][B](1)
    - Mean arterial pressure[C] less than 70 mm Hg[A][B] MAP Calculator(1)(2)
    - Decrease in baseline systolic blood pressure of 30 mm Hg or more, with significant signs or symptoms due to lower blood pressure (eg, near syncope, syncope, chest pain)[A][B](1)
  - Hypotension in pediatric patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure less than 110 mm Hg in child 13 to 17 years of age[A][D](3)
    - Systolic blood pressure less than 100 mm Hg in child 6 to 12 years of age[A][D](3)
    - Systolic blood pressure less than 95 mm Hg in child 3 to 5 years of age[A][D](3)
    - Systolic blood pressure less than 90 mm Hg in child 1 or 2 years of age[A][D](3)
    - Systolic blood pressure less than 80 mm Hg in infant 6 to 11 months of age[A][D](3)
    - Systolic blood pressure less than 70 mm Hg in infant 3 to 5 months of age[A][D](3)
    - Systolic blood pressure less than 65 mm Hg in infant 1 or 2 months of age[A][D](3)

### References


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3. Anderson CC, Kapoor S, Mark TE. Pediatric parameters and equipment. In: Anderson CC, Kapoor S, Mark TE, editors. The Harriet Lane Handbook: A Manual for Pediatric House Officers. 23rd ed. Elsevier; 2024:i-iii.

### Footnotes

A. Criteria based upon clinician-acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.
B. Interpretation of blood pressure requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline blood pressure, medications, and clinical impact. For example, an elderly patient with heart failure may be prescribed medication with the intentional goal of a reduced pressure. If the patient's baseline SBP is 92 mm Hg to 96 mm Hg, absent signs or symptoms of hypotension, an emergency department SBP of 86 mm Hg should not automatically be categorized as hypotensive. This would hold for mean arterial pressure (MAP) as well. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term hypotension. Whether a blood pressure below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.
C. The mean arterial pressure (MAP) takes into account both SBP and DBP readings.
D. Interpretation of blood pressure requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline blood pressure, medications, and clinical impact. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term hypotension. Whether a blood pressure below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

## Tachycardia

- Tachycardia,[A][B] as indicated by **1 or more** of the following:
  - Heart rate greater than 100 beats per minute in adult[A][B](1)
  - Heart rate greater than 85 beats per minute in child 13 to 17 years of age[A][C](2)
  - Heart rate greater than 95 beats per minute in child 6 to 12 years of age[A][C](2)
  - Heart rate greater than 110 beats per minute in child 1 to 5 years of age[A][C](2)
  - Heart rate greater than 120 beats per minute in infant 3 to 11 months of age[A][C](2)
  - Heart rate greater than 150 beats per minute in infant 1 or 2 months of age[A][C](2)

### References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
2. Anderson CC, Kapoor S, Mark TE. Pediatric parameters and equipment. In: Anderson CC, Kapoor S, Mark TE, editors. The Harriet Lane Handbook: A Manual for Pediatric House Officers. 23rd ed. Elsevier; 2024:i-iii.

### Footnotes

A. Criteria based upon clinician acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

B. Interpretation of heart rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline heart rate, medications, and clinical impact. For example, an elderly patient on a beta-blocker medication with a baseline resting heart rate of 60 beats per minute may be clinically tachycardic at a heart rate of 94 beats per minute. Likewise, a patient who is upset, in pain, or nervous in the emergency department with a heart rate of 106 beats per minute may meet the technical definition of tachycardia, but this tachycardia (absent associated findings such as chest pain or hypotension) may not be clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachycardia. Whether a heart rate above or below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

C. Interpretation of heart rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline heart rate, medications, and clinical impact. A patient who is upset, in pain, or nervous in the emergency department with an elevated heart rate may meet the technical definition of tachycardia, but this tachycardia (absent associated findings such as hypotension) may not be clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachycardia. Whether a heart rate above or below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

# Codes

**ICD-10 Diagnosis: E86.1, I95.0, I95.1, I95.2, I95.3, I95.81, I95.89, I95.9, N99.0, R34, R57.0, R57.1, R57.8, R57.9, R65.21, T78.2XXA, T79.4XXA, T81.10XA, T81.11XA, T81.12XA, T81.19XA, T88.2XXA [Hide]**



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