Percutaneous Coronary Intervention

ORG: M-52 (ISC)
Link to Codes

MCG Health
Inpatient & Surgical Care
30th Edition

Care Planning - Inpatient Admission and Alternatives

Clinical Indications for Procedure

- Procedure is indicated for **1 or more** of the following[A](1)(2):
  - Left main coronary artery stenosis, as indicated by **ALL** of the following:
    - Significant left main coronary artery stenosis, as indicated by **1 or more** of the following(1)(2):
      - 50% or more luminal diameter narrowing
      - Lumen diameter of less than 2.8 mm

- Lumen area of less than 6 mm^2
- Fractional flow reserve (FFR) less than 0.80[B]
- Instantaneous wave-free ratio (iFR) less than 0.89[B]

- Percutaneous coronary intervention appropriate (eg, judged that PCI will provide equivalent revascularization compared with CABG, or patient is a poor surgical candidate)

- Coronary artery (other than left main) stenosis (ie, vessel(s) with greater than or equal to 70% stenosis, FFR less than 0.80, or iFR less than 0.89)[B] with symptoms due to cardiac ischemia (eg, chest pain, dyspnea) that persist despite maximally tolerated doses of antianginal medications (2 or more medications, including beta-blocker if tolerated)[C](1)(2)(11)
- Clinically significant (eg, causing angina, myocardial ischemia) in-stent restenosis (eg, 50% or greater restenosis)(1)
- History of ventricular fibrillation, polymorphic ventricular tachycardia, or cardiac arrest presumed to be ischemia-mediated due to coronary artery disease amenable to PCI[D](1)
- Recent (eg, within 45 days) STEMI or NSTEMI with culprit artery-only PCI performed at time of the infarct with one or more non-culprit coronary arteries (not left main) with significant stenosis (70% or more stenosis, FFR less than 0.80, or iFR less than 0.89)[E](1)(13)
- Planned transcatheter aortic valve replacement and significant stenosis of left main (eg, 50% or more stenosis) or proximal coronary artery (70% or more stenosis, FFR less than 0.80, or iFR less than 0.89)(1)
- Coronary artery pseudoaneurysm(4)(5)
- Coronary artery dissection and **1 or more** of the following[F](1)(14):
  - Ongoing ischemia
  - Hemodynamic instability

Alternatives to Procedure

- Alternatives include(1)(2)(11)(15):
  - Optimal medical therapy with antianginal medications and risk-reduction therapy, including lipid-lowering, antiplatelet, and antihypertensive medications, diabetic control, exercise, nutrition, smoking cessation, and weight loss counseling(2)(11)(15)
  - Enhanced external counterpulsation[G](2)(23)(24)
  - Hybrid coronary revascularization (combining coronary angiography and PCI with minimally invasive left internal mammary artery surgical bypass grafting)[H](25)
  - Totally endoscopic coronary artery bypass surgery[I]
  - Minimally invasive coronary bypass surgery. See Coronary Artery Bypass Graft, Minimally Invasive Direct (MIDCAB) ISC guideline.
  - Coronary artery bypass grafting. See Coronary Artery Bypass Graft (CABG) ISC guideline.

Operative Status Criteria

Goal Length of Stay: Ambulatory

Note: The definition of an ambulatory procedure depends on payer-provider contractual agreement or regulatory language (eg, CMS' Two-Midnight Rule). An ambulatory procedure may include one postoperative overnight stay in a facility; therefore, MCG's ambulatory Goal Length of Stay (GLOS) attainment calculation reports the sum of same-day and next-day postoperative discharges. Depending on various patient and procedural factors, some patients undergoing a procedure with an ambulatory GLOS require inpatient care (eg, medical necessity for hospital-based care across 2 or more postoperative midnights). Some of these factors are described in the Extended Stay section of this guideline.

- Ambulatory

- Inpatient (eg, medical necessity for hospital-based care across 2 or more postoperative midnights)
- Inpatient (Medicare patient, and specific procedure is on CMS Inpatient Only List)

Hospitalization

Optimal Recovery Course

Day	Level of Care	Clinical Status	Activity	Routes	Interventions	Medications
1	• Catheterization lab • Social Determinants of Health Assessment • Recovery room, intermediate care, or floor to discharge • Discharge planning	• **Hemodynamic stability** • **Arterial puncture site without evidence of infection, aneurysm, or growing hematoma[J]** • **No evidence of ongoing myocardial ischemia** • **No evidence of vascular compromise distal to puncture site** • **Discharge plans and education understood**	• **Ambulatory or acceptable for next level of care[K]**	• **Oral hydration[L]** • **Oral medications or regimen acceptable for next level of care** • **Oral diet or acceptable for next level of care**	• **Vascular sheath removed** • Probable stent • ECG, Troponin • Cardiac monitoring	• Aspirin • Antiplatelet agent (eg, clopidogrel, ticagrelor, IV cangrelor) • Anticoagulant therapy • Lipid-lowering agent • Beta-blocker • Possible antihypertensive medication

(1)(29)(30)(31)

Recovery Milestones are indicated in **bold**.

Goal Length of Stay: Ambulatory

Note: Goal Length of Stay assumes optimal recovery, decision making, and care. Patients may be discharged to a lower level of care (either later than or sooner than the goal) when it is appropriate for their clinical status and care needs.

Extended Stay

Minimal (a few hours to 1 day), Brief (1 to 3 days), Moderate (4 to 7 days), and Prolonged (more than 7 days).

- Inpatient stay (eg, need for hospital-based care beyond postoperative day 1) may be needed for(1)(32):
  - Failure to meet discharge criteria (recovery milestones in Optimal Recovery Course)
    - Expect brief stay extension.
  - Percutaneous coronary intervention after acute MI(12)(33)
    - See Myocardial Infarction ISC guideline.
  - Persistent postprocedural instability (eg, Hypotension, chest pain, dyspnea)
    - Expect brief to moderate stay extension.

- Intravascular procedural complications such as acute vessel closure, stent thrombosis, stent malposition or embolization, pseudoaneurysm, device entrapment, air embolism, side branch closure, vessel dissection or perforation(4)(5)(34)(35)(36)
  - Anticipate ultrasound or other imaging, topical compression, urgent repeat endovascular intervention, mechanical circulatory support, or surgery.
  - Coronary perforation may require pericardiocentesis and endovascular or surgical intervention.(36)
  - Expect minimal to brief stay extension for repeat intervention.
  - Expect brief to moderate stay extension for surgical intervention.
- Extravascular procedural complications such as retroperitoneal hematoma, forearm hematoma and compartment syndrome, pericardial effusion, or cardiac tamponade(35)(36)
  - Anticipate imaging, echocardiography, pericardiocentesis, or surgery.
  - Expect brief stay extension.
- Entry site complications causing bleeding, hematoma, or distal ischemia and requiring ongoing monitoring, surgical repair, or surgical thrombectomy(35)(36)
  - Expect minimal to brief stay extension.
- Urgent or emergent CABG surgery needed(37)
  - Expect brief to moderate stay extension.
  - See Coronary Artery Bypass Graft (CABG) ISC guideline.
- Cerebrovascular accident(38)
  - Patients with underlying carotid artery disease, atrial fibrillation, and older age are at higher risk.
  - Anticipate brain imaging studies and neurologic monitoring.
  - Expect brief stay extension.
- Periprocedural MI(34)(39)
  - Anticipate cardiac monitoring and repeat biomarker (eg, Troponin) testing.
  - Expect brief stay extension.
- Acute kidney injury(40)
  - Anticipate fluid and electrolyte monitoring and possible renal replacement therapy.
  - Expect brief stay extension.
- Patient requiring mechanical circulatory support during procedure(41)
  - Expect brief to moderate stay extension.

See Common Complications and Conditions ISC for further information.

Discharge

Discharge Planning

- Discharge planning includes[M]:
  - Assessment of needs and planning for care, including(43)(44):
    - Develop and modify treatment plan (involving multiple providers) as needed.
    - Evaluate and address preadmission functioning as needed.
    - Evaluate and address psychosocial status issues as indicated. See Psychosocial Assessment SR for further information.
    - Evaluate and address social determinants of health (eg, housing, food). See Social Determinants of Health Screening Tool SR for further information.(45)(46)
    - Evaluate and address patient or caregiver preferences as indicated.

- Identify skilled services needed at next level of care, with specific attention to:
  - Cardiovascular status assessment(47)(48)
  - Medication management, adherence instruction, and side effects assessment(49)(50)
  - Wound or dressing management

- Early identification of anticipated discharge destination; options include(44)(51):
  - Home; considerations include:
    - Home safety assessment. See Home Safety Assessment SR for further information.
    - Patient safe to go home; examples include(52)(53)(54):
      - Medical status stable for patient's condition
      - Functional care can safely be provided with available resources.
      - Mental status stable for patient's condition
      - Medication availability confirmed and reconciliation complete
      - Patient/caregiver education completed with written discharge instructions provided
      - Community resources identified and referrals made, as needed
      - Home care arranged, if indicated
      - Necessary medical equipment delivery arranged or available in home, if indicated
      - Necessary medical supplies ordered, or patient/caregiver can obtain, if indicated
    - Access to follow-up care
    - Self-management ability if appropriate. See Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) Assessment SR for further information.
    - Caregiver need, ability, and availability
  - Post-acute skilled care or custodial care as indicated. See Discharge Planning Tool SR for further information.
- Transitions of care plan complete, including(44)(51)(55):
  - Patient and caregiver education complete.
    - See Teach-Back Tool SR for further information.
    - See Percutaneous Coronary Intervention: Patient Education for Clinicians SR for further information.
  - Medication reconciliation completion includes(50)(56):
    - Compare patient's discharge list of medications (prescribed and over-the-counter) against provider's admission or transfer orders.
    - Assess each medication for correlation to disease state or medical condition.
    - Report medication discrepancies to prescribing provider, attending physician, and primary care provider, and ensure accurate medication order is identified.
    - Provide reconciled medication list to all treating providers.
    - Confirm that patient or caregiver can acquire medication.
    - Educate patient and caregiver.
      - Provide complete medication list to patient and caregiver.
      - Importance of presenting personal medication list to all providers at each care transition, including all provider appointments
      - Reason, dosage, and timing of medication (eg, use "teach-back" techniques)(57)
    - Encourage communication between patient, caregiver, and pharmacy for obtaining prescriptions, setting up home medication delivery, and reviewing for drug-drug interactions.
    - See Medication Reconciliation Tool SR for further information.
  - Plan communicated to patient, caregiver, and all members of care team, including(58):

    - Inpatient care and service providers
    - Primary care provider
    - All post-discharge care and service providers
- Appointments planned or scheduled, which may include:
    - Primary care provider(59)
    - Cardiologist(12)
    - Interventional cardiologist(49)
    - Rehabilitation therapy services(12)(29)(60)
    - Specialists for management of comorbidities as needed(3)
    - Other
- Outpatient testing and procedure plans made, which may include:
    - Echocardiogram(47)
    - Exercise stress test(12)
    - Laboratory testing(12)
    - Other
- Referrals made for assistance or support, which may include:
    - Educational program (eg, chronic condition management, self-management)(59)(61)
    - Financial, for follow-up care, medication, and transportation
    - Tobacco use treatment(48)(62)(63)
    - Other
- Medical equipment and supplies coordinated (ie, delivered or delivery confirmed), which may include:
    - Wound care equipment and supplies(64)
    - Other

Discharge Destination

- Post-hospital levels of admission may include:
    - Home.
    - Home healthcare. See Home Care Indications for Admission Section HC in Percutaneous Coronary Intervention guideline in Home Care.

Evidence Summary

Background

Coronary artery angioplasty with or without stent placement is known as percutaneous coronary intervention.(3) **(EG 2)**

The Angina ISC guideline is to be used when the diagnosis of unstable angina is made (ie, the etiology of signs and symptoms is myocardial ischemia in a pattern or presentation consistent with a diagnosis of unstable angina (not stable angina)). The Chest Pain ISC guideline is to be used for patients with symptoms (eg, chest pain) of unknown etiology (eg, rule out MI). The Percutaneous Coronary Intervention guideline, which is intended for planned elective PCI, is to be used for patients with chronic stable angina undergoing elective PCI.

Criteria

The evidence for the clinical indications found in this guideline includes 9 published peer reviewed articles, 3 specialty society or other evidence-based guidelines, and 2 book sections.

A specialty society guideline states that PCI is appropriate for patients with left main coronary artery stenosis if it will provide equivalent revascularization compared with CABG.(1) **(EG 2)** For significant coronary artery (other than left main) stenosis, appropriate-use criteria supported by multiple specialty societies recommend PCI for those with symptoms due to ischemia that persist despite maximally tolerated doses of 2 or more antianginal medications.(1) **(EG 2)** For ventricular fibrillation, polymorphic ventricular tachycardia, or cardiac arrest presumed to be ischemia-mediated, a specialty society guideline recommends PCI for patients with significant coronary artery stenosis.(1) **(EG 2)** For recent NSTEMI or STEMI with culprit artery-only PCI performed, a specialty society guideline recommends additional PCI for those with significant non-culprit artery stenosis to reduce risk of further cardiovascular events.(1) **(EG 2)** For coronary artery pseudoaneurysm, a cardiology textbook and a narrative review support PCI with stenting to diminish blood flow into the aneurysm.(4)(5) **(EG 2)** For spontaneous coronary artery dissection, a specialty society guideline notes that PCI may be appropriate in the setting of ongoing ischemia or hemodynamic instability.(1) **(EG 2)**

Alternatives

Revascularization has been found to reduce angina and improve quality of life in patients with angina that persists despite optimal medical therapy.(16)(17)(18) **(EG 1)** Two evidence-based American College of Cardiology (ACC) guidelines concur that elective revascularization is appropriate for treatment-resistant angina.(1)(2) **(EG 2)**

Randomized trials examining the benefit of PCI in patients with stable multivessel coronary artery disease and reduced ejection fraction failed to demonstrate a benefit in terms of mortality, arrhythmia, or hospitalization for heart failure compared with optimal medical therapy.(19)(20)(21) **(EG 1)** A systematic review of randomized controlled trials concludes that compared with optimal medical therapy, revascularization with PCI has not been shown to reduce the incidence of MI or death in patients with stable coronary artery disease.(22) **(EG 1)**

Hospitalization

A specialty society guideline, based upon a systematic review of the randomized controlled trial literature, concludes that radial artery access is preferred for PCI, including in patients with acute coronary syndromes, due to reduced rates of major bleeding, vascular complications, and mortality (in acute coronary syndrome patients).(1) **(EG 2)**

Length of Stay

Analysis of procedure data for a commercially insured population shows 89% of patients undergoing elective PCI were discharged the day of or the day after surgery.(31) **(EG 3)** Analysis of procedure data for a Medicare-insured population shows 85% of patients undergoing elective PCI were discharged the day of or the day after surgery.(31) **(EG 3)**

Rationale

Use of this MCG care guideline helps the clinician identify, for a given procedure, which patient-specific factors and clinical conditions are appropriate for that procedure. The evidence-based clinical criteria assist the clinician in the decision to appropriately perform a procedure, evaluating whether the potential benefits of a procedure outweigh the potential risks. For Medicare enrollees, surgical MCG care guidelines also identify which procedures CMS has designated as inpatient only.

Use of these evidence-based clinical criteria to support decision making around the need for a given procedure is of benefit to the patient, as all procedures come with inherent risk that must be balanced by anticipated clinical benefit. Utilizing evidence-based clinical criteria enables a more accurate and patient-specific decision-making process. In addition, the use of evidence-based guidelines can help reduce unwarranted variation in care, such as divergent clinical thresholds to perform a procedure for clinically similar patients that vary across geographic regions, between facilities, and among individual clinicians.

Related CMS Coverage Guidance

This guideline supplements but does not replace, modify, or supersede existing Medicare regulations or applicable National Coverage Determinations (NCDs) or Local Coverage Determinations (LCDs).

Code of Federal Regulations (CFR): 42 CFR 412.3(65); 42 CFR 419.22(66); 42 CFR 422.101(67)

Internet-Only Manual (IOM) Citations: CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 1 - Inpatient Hospital Services Covered Under Part A(68); CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 6 - Hospital Services Covered Under Part B(69); CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 15 - Covered Medical and Other Health Services(70); CMS IOM Publication 100-08, Medicare Program Integrity Manual, Chapter 6, Section 6.5 - Medical Review of Inpatient Hospital Claims for Part A Payment(71)

Medicare Coverage Determinations: Medicare Coverage Database(72)

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Footnotes

[A] The Angina ISC guideline is to be used when the diagnosis of unstable angina is made (ie, the etiology of signs and symptoms is myocardial ischemia in a pattern or presentation consistent with a diagnosis of unstable angina (not stable angina)). The Chest Pain ISC guideline is to be used for patients with symptoms (eg, chest pain) of unknown etiology (eg, rule out MI). The Percutaneous Coronary Intervention guideline, which is intended for planned elective PCI, is to be used for patients with chronic stable angina undergoing elective PCI. [A in Context Link 1]

[B] PCI may be guided by conventional angiography based on luminal narrowing of the coronary arteries, by using physiologic measures of coronary flow, or by intravascular imaging (ultrasound or optical coherence tomography).(6)(7)(8)(9)(10) Two means by which to identify stenoses as physiologically important are via fractional flow reserve (FFR) or instantaneous wave-free ratio (iFR).(6)(7)(8) FFR is the ratio of pressure distal to a stenosis relative to the pressure proximal to the stenosis. The lower the ratio, the more hemodynamically significant the stenosis.(6) iFR is similar in concept to FFR but does not require the administration of adenosine during angiography as is required for the measurement of FFR.(7)(8) Adenosine is not universally available, is expensive, can cause bradycardia, and commonly induces chest pain or dyspnea in patients.(7)(8) A specialty society guideline recommends that PCI not be performed above a threshold FFR of 0.80 or iFR of 0.89.(1) [B in Context Link 1, 2, 3]

[C] Some patients may have documented contraindications, intolerable side effects, or allergy to one or more classes of antianginal medications, thus reducing (or even eliminating) available options.(1) [C in Context Link 1]

[D] The PCI guideline applies to patients undergoing elective PCI due to a **history** of cardiac arrhythmia (not currently present or the reason for acute presentation) that is felt to be caused (at least in part) by myocardial ischemia due to a lesion or lesions amenable to PCI. Patients presenting **acutely** (eg, to the emergency department) for an arrhythmia would be appropriate for the guideline concerning that arrhythmia (eg, Ventricular Arrhythmia ISC guideline). Patients presenting with acute myocardial ischemia are appropriate for the Angina ISC or Myocardial Infarction ISC guideline. [D in Context Link 1]

[E] A specialty society guideline for coronary artery revascularization recommends that hemodynamically stable patients with STEMI or NSTEMI treated initially with PCI of the identified culprit artery may undergo PCI of non-culprit arteries either as part of the initial procedure, as a second procedure before discharge, or as a planned interval procedure following discharge.(12) [E in Context Link 1]

[F] Most patients with acute spontaneous coronary artery dissection may be treated without intervention. PCI or CABG should be considered in patients with ongoing ischemia or hemodynamic instability.(1)(14) [F in Context Link 1]

[G] Enhanced external counterpulsation is a technique that uses inflatable cuffs wrapped around the lower extremities to increase venous return and augment diastolic blood pressure.(23)(24) [G in Context Link 1]

[H] A specialty society guideline suggests the use of hybrid revascularization for patients with left anterior descending (LAD) coronary artery disease and either 2-vessel disease with an LAD lesion not amenable to PCI or multivessel disease with either contraindication to full sternotomy, no available arterial or venous conduits for bypass, poor surgical targets for circumflex or right coronary artery bypass (eg, poor runoff, extensive coronary calcification, or extensive aortic atheroma with need for aortic manipulation to bypass) that are amenable to PCI, or as a staged procedure after emergent minimally invasive direct coronary artery bypass (MIDCAB).(25) [H in Context Link 1]

[I] Totally endoscopic coronary artery bypass (TECAB) is performed endoscopically through small port incisions on the left thorax using robotic assistance technology and remote-access cardiopulmonary bypass. In contrast to robotic minimally invasive direct coronary artery bypass (MIDCAB), TECAB can be used to bypass multiple arteries and is not limited to bypassing the left anterior descending artery.(26) [I in Context Link 1]

[J] Radial access leads to fewer bleeding and vascular complications than femoral access.(27) [J in Context Link 1]

[K] Patients with uncomplicated femoral catheterization procedures and femoral artery closure via a closure device may safely ambulate after 2 hours.(28) [K in Context Link 1]

[L] Some patients may have their hydration needs met via alternative means (eg, percutaneous endoscopic gastrostomy tube). [L in Context Link 1]

[M] Discharge instructions should be given in the patient's and caregiver's native language using trained language interpreters whenever possible.(42) [M in Context Link 1]

Definitions

Altered mental status

- Altered mental status (ie, different from baseline), as indicated by **1 or more** of the following(1)(2)(3)(4):
  - Confusional state (eg, disorientation, difficulty following commands, deficit in attention)
  - Lethargy (eg, awake or arousable, but with drowsiness; reduced awareness of self and environment)
  - Obtundation (ie, arousable only with strong stimuli, lessened interest in environment, slowed responses to stimulation)
  - Stupor (ie, may be arousable but patient does not return to normal baseline level of awareness)
  - Coma (ie, not arousable)

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Hemodynamic instability

- Hemodynamic instability, as indicated by **1 or more** of the following:
  - Vital sign abnormality not corrected by appropriate treatment, as indicated by **1 or more** of the following[A]:
    - Tachycardia that persists despite appropriate treatment (eg, treatment of underlying cause, despite observation care)[A]
    - Hypotension that persists despite appropriate treatment (eg, treatment of underlying cause, despite observation care)[A]
    - Orthostatic hypotension that persists despite appropriate treatment (eg, treatment of underlying cause, despite observation care)[A]
  - Severe hypotension in adult patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure less than 80 mm Hg(1)[A]
    - Shock index greater than 1.0 (shock index is the heart rate divided by systolic blood pressure)[A](2)(3)(4)

- Mean arterial pressure[B] less than 65 mm Hg MAP Calculator[A](1)(6)
- IV inotropic or vasopressor medication required to maintain adequate blood pressure or perfusion(3)(6)
- Hypoperfusion due to hypotension, as indicated by **ALL** of the following:
  - Hypotension
  - Evidence of hypoperfusion, 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)[C](3)(6)(8)
    - Metabolic acidosis (arterial or venous[D] pH less than 7.35) not otherwise explained(3)(6)(8)
    - Significant end organ dysfunction due to hypotension (eg, Altered mental status, myocardial ischemia, 2-fold or higher acute increase in serum creatinine)(3)(6)

- Severe hypotension in pediatric patient, as indicated by **1 or more** of the following:
  - Systolic blood pressure less than 80 mm Hg in child 6 to 17 years of age[A](14)
  - Systolic blood pressure less than 75 mm Hg in child 6 months to 5 years of age[A](14)
  - Shock index greater than 0.9 in child 13 to 17 years of age (shock index is the heart rate divided by systolic blood pressure)[A](2)(15)
  - Shock index greater than 1.0 in child 7 to 12 years of age (shock index is the heart rate divided by systolic blood pressure)[A](2)(15)
  - Shock index greater than 1.2 in child 4 to 6 years of age (shock index is the heart rate divided by systolic blood pressure)[A](2)(15)
  - IV inotropic or vasopressor medication required to maintain adequate blood pressure or perfusion(5)(6)
  - Hypoperfusion due to hypotension, as indicated by **ALL** of the following:
    - Hypotension
    - Evidence of hypoperfusion, 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)[C](6)(8)
      - Metabolic acidosis (arterial or venous pH less than 7.35) not otherwise explained[D](5)(6)(14)
      - Significant end organ dysfunction due to hypotension (eg, Altered mental status, myocardial ischemia, 2-fold or higher acute increase in serum creatinine)(5)(6)(14)

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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. The mean arterial pressure (MAP) takes into account both SBP and DBP readings.(3)(5)
C. 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.(7)(8)
D. Analyses have concluded that venous and arterial pH measurements are highly correlated, with small differences between them that are usually not clinically significant.(9)(10)(11)(12)(13) If a mixed acid-base disorder is suspected, an arterial blood gas is indicated.(10)

Hemodynamic stability

- Hemodynamic stability, as indicated by **1 or more** of the following:
  - Hemodynamic abnormalities at baseline or acceptable for next level of care
  - Patient hemodynamically stable, as indicated by **ALL** of the following(1)(2):
    - Tachycardia absent
    - Hypotension absent
    - No evidence of inadequate perfusion (eg, no myocardial ischemia)
    - No other hemodynamic abnormalities (eg, no Orthostatic hypotension)

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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)

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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. 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.

Hypotension absent

- Hypotension absent,[A] as indicated by **1 or more** of the following:
  - Hypotension absent in adult patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure greater than or equal to 90 mm Hg[A](1)
    - Mean arterial pressure[B] greater than or equal to 70 mm Hg MAP Calculator[A](1)(2)
    - Blood pressure at patient's baseline (eg, healthy adult with low systolic blood pressure), at intentional therapeutic goal (eg, patient with heart failure), or acceptable for next level of care (eg, blood pressure stable and no significant signs or symptoms due to low blood pressure)
  - Hypotension absent in pediatric patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure greater than or equal to 110 mm Hg in child 13 to 17 years of age[A](3)
    - Systolic blood pressure greater than or equal to 100 mm Hg in child 6 to 12 years of age[A](3)
    - Systolic blood pressure greater than or equal to 95 mm Hg in child 3 to 5 years of age[A](3)
    - Systolic blood pressure greater than or equal to 90 mm Hg in child 1 or 2 years of age[A](3)
    - Systolic blood pressure greater than or equal to 80 mm Hg in infant 6 to 11 months of age[A](3)
    - Systolic blood pressure greater than or equal to 70 mm Hg in infant 3 to 5 months of age[A](3)
    - Systolic blood pressure greater than or equal to 65 mm Hg in infant 1 or 2 months of age[A](3)
    - Blood pressure at patient's baseline (eg, healthy child with low systolic blood pressure), at intentional therapeutic goal, or acceptable for next level of care (eg, blood pressure stable and no significant signs or symptoms due to low blood pressure)

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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.
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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. The mean arterial pressure (MAP) takes into account both SBP and DBP readings.

Orthostatic hypotension

- Orthostatic hypotension,[A][B] as indicated by **1 or more** of the following(1)(2)(3):
  - Fall in SBP of 20 mm Hg or more 1 to 3 minutes after patient sits or stands from recumbent position
  - Fall in DBP of 10 mm Hg or more 1 to 3 minutes after patient sits or stands from recumbent position

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Footnotes

A. Concomitant measurements of the heart rate are important to measure to help diagnose subtypes of orthostatic hypotension (eg, the lack of a compensatory increase in heart rate is typical of autonomic failure and an exaggerated tachycardia may be reflective of volume depletion). However, the heart rate is not a component of the definition of orthostatic hypotension, which relies upon blood pressure alone.(1)(2)(3)

B. 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.

Social Determinants of Health Assessment

- Risk of poor health outcomes may be increased by the presence of **1 or more** of the following social determinants of health(1)(2)(3):
  - Housing insecurity, as indicated by **1 or more** of the following:
    - Individual or caregiver's current living situation is **1 or more** of the following(4):
      - Does not have own housing (eg, staying in a hotel, shelter, or with others)
      - Has own housing (eg, house, apartment), but at risk of losing it in the future (ie, behind on rent or mortgage)
      - Has own housing (eg, house, apartment), but has lived in 3 or more places in past year
    - Current housing has **1 or more** of the following:
      - Electrical appliances (eg, stove, refrigerator) not working or unavailable
      - Insufficient heating or cooling
      - Insufficient ventilation
      - Lead paint or pipes
      - Mold
      - Pests (eg, bugs) or rodents
      - Smoke detectors not working or unavailable
  - Food insecurity, as indicated by **1 or more** of the following(5):
    - In the past year, individual or caregiver ran out of food and did not have money to buy more food.
    - In the past year, individual or caregiver worried that they would run out of food before they received money to buy more food.
  - Insufficient transportation, as indicated by **1 or more** of the following(6):
    - In the past year, individual or caregiver missed medical appointments or could not get medications due to lack of transportation.
    - In the past year, individual or caregiver missed nonmedical activities, work, or could not get things needed for daily living due to lack of transportation.
  - Insufficient utilities, as indicated by **1 or more** of the following(7):
    - Utilities (eg, electricity, water, gas, or oil) are currently shut off or unavailable.
    - In the past year, electric, water, gas, or oil company threatened to shut off services.
  - Personal safety risk, as indicated by **2 or more** of the following(5):
    - Individual is sometimes or frequently physically hurt by another person (including family member).
    - Individual is sometimes or frequently insulted or talked down to by another person (including family member).
    - Individual is sometimes or frequently threatened with physical harm by another person (including family member).

- Individual is sometimes or frequently screamed or cursed at by another person (including family member).
- Insufficient dependent care, as indicated by **1 or more** of the following:
  - In the past year, individual or caregiver was unable to work due to lack of dependent care.
  - In the past year, individual or caregiver was unable to work more (additional) hours due to lack of dependent care.
  - In the past year, individual or caregiver missed medical appointments or could not get medications due to lack of dependent care.
  - In the past year, individual or caregiver missed nonmedical activities (eg, school, church, social activity) due to lack of dependent care.
- Depression risk, as indicated by **ALL** of the following(8):
  - In the past 2 weeks, individual had little interest or pleasure in normal activities on at least several days.
  - In the past 2 weeks, individual felt down, depressed, or hopeless on at least several days.

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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.

Tachycardia absent

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

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Troponin

- Troponin elevation alone does not indicate acute myocardial infarction; factors to consider include(1)(2):
  - Patients can have elevated levels of cardiac troponin due to other causes of myocardial injury, either acutely or chronically (eg, heart failure, myocarditis, pulmonary embolism, cardiomyopathy, defibrillator shock).
  - Patients with an elevated troponin should, on subsequent measurement, have a fall or rise in the troponin level of more than 20% to confirm acuity of myocardial injury. Absent this variation, the acuity of the myocardial injury should be questioned.
  - Attributing acute troponin release to myocardial ischemia depends on the presence of associated symptoms (eg, chest pain, dyspnea), ECG changes (eg, acute ST-segment deviation), and imaging findings (eg, new wall motion abnormalities on echocardiogram).
  - A report from a facility (eg, hospital) laboratory of an elevated troponin level, in general, indicates a level above the 99th percentile for the specific troponin assay used. The precise value that represents the 99th percentile depends on the specific troponin assay used.
  - The recommended time interval between serial troponin level assessments (eg, to detect fall or rise in troponin level) is 1 to 3 hours for high-sensitivity troponin, and 3 to 6 hours for conventional (contemporary) troponin assays.
  - Evidence-based specialty society guidelines recommend use of high-sensitivity troponin assays, rather than older less-sensitive assays (collectively labeled contemporary assays).(1)(3) This is due to more rapid detection or exclusion of myocardial injury and increased diagnostic accuracy with high-sensitivity assays.(1)(3)

References

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Codes

ICD-10 Diagnosis: I23.7, I24.0, I24.89, I24.9, I25.811, I25.83, I25.84, T82.855A

ICD-10 Procedure: 0270346, 027034Z, 0270356, 027035Z, 0270366, 027036Z, 0270376, 027037Z, 02703D6, 02703DZ, 02703E6, 02703EZ, 02703F6, 02703FZ, 02703G6, 02703GZ, 02703T6, 02703TZ, 02703Z6, 02703ZZ, 02704DZ, 0271346, 027134Z, 0271356, 027135Z, 0271366, 027136Z, 0271376, 027137Z, 02713D6, 02713DZ, 02713E6, 02713EZ, 02713F6, 02713FZ, 02713G6, 02713GZ, 02713T6, 02713TZ, 02713Z6, 02713ZZ, 0272346, 027234Z, 0272356, 027235Z, 0272366, 027236Z, 0272376, 027237Z, 02723D6, 02723DZ, 02723E6, 02723EZ, 02723F6, 02723FZ, 02723G6, 02723GZ, 02723T6, 02723TZ, 02723Z6, 02723ZZ, 0273346, 027334Z, 0273356, 027335Z, 0273366, 027336Z, 0273376, 027337Z, 02733D6, 02733DZ, 02733E6, 02733EZ, 02733F6, 02733FZ, 02733G6, 02733GZ, 02733T6, 02733TZ, 02733Z6, 02733ZZ, 02C03Z6, 02C03Z7, 02C03ZZ, 02C13Z6, 02C13Z7, 02C13ZZ, 02C23Z6, 02C23Z7, 02C23ZZ, 02C33Z6, 02C33Z7, 02C33ZZ, 02F03ZZ, 02F13ZZ, 02F23ZZ, 02F33ZZ, XW0J3HA, XW0J3JA, XW0J3KA, XW0J3LA, XW0K3HA, XW0K3JA, XW0K3KA, XW0K3LA, XW0L3HA, XW0L3JA, XW0L3KA, XW0L3LA, XW0M3HA, XW0M3JA, XW0M3KA, XW0M3LA [Hide]

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