

Renal Failure: Common Complications and Conditions

CCC: CCC-031 (ISC)

[Link to Codes](#)

MCG Health
Inpatient & Surgical Care
30th Edition

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Prevention

- Prevention issues and possible preventive measures include:

- ☐ Maintain awareness of patient characteristics and situations that pose high risk for development of renal failure or injury[A]; examples include(4):
 - Pre-existing renal dysfunction or renal anomalies(1)(4)(5)
 - Proteinuria(1)(2)(5)
 - Younger age (eg, younger than 5 years)(2)(6)(7)
 - Older age (eg, older than 65 years)(1)(4)(8)
 - Hypovolemia (eg, due to acute blood loss, severe vasoconstriction)(1)(4)(9)
 - Hypotension(1)(10)
 - Hypertension(7)(8)(11)
 - Sepsis(1)(4)(12)
 - Diabetes mellitus(11)(13)(14)
 - Heart failure(1)(3)(15)
 - Advanced chronic liver disease (eg, cirrhosis)(1)(16)(17)
 - Rhabdomyolysis (eg, from crush injury) and other trauma(7)(8)(18)
 - Tumor lysis syndrome(19)(20)
 - Malignancy(1)(4)(11)
 - Poor nutritional status (eg, hypoalbuminemia)(21)
 - Peripheral vascular disease (eg, atheroemboli to renal arteries)(22)
 - Thrombotic microangiopathies (eg, thrombotic thrombocytopenic purpura, hemolytic uremic syndrome)(6)(23)(24)
 - Intraperitoneal, intrathoracic, or suprainguinal vascular surgery(1)(25)

- Cardiac surgery(3)(4)(26)
- Interventional cardiac and/or vascular surgery(27)
- Respiratory failure (eg, mechanical ventilation, pneumonia, severe acute respiratory syndrome)(8)(28)
- Myeloablative therapy for hematopoietic stem cell transplant(29)(30)
- Solid organ transplant(2)(31)
- Extracorporeal membrane oxygenation(32)(33)
- Burn injuries(4)(7)(8)
- Correct hypovolemia with prompt and controlled volume expansion.(4)(9)(34)(35)
- Use vasopressors, if necessary, to maintain adequate perfusion pressure.(4)(34)(35)
- Adjust medication dosages as needed for level of renal function in patient with kidney disease.(5)(34)(36)
- Monitor volume status and avoid volume overload in patients with chronic kidney disease.(37)
- ☐ Avoid nephrotoxic agents when possible, and adjust doses for renal function if use is unavoidable; examples include(32)(35)(38):
 - Antimicrobials (eg, aminoglycosides, amphotericin B)(23)
 - Use once-daily administration of aminoglycoside when possible.(4)(23)
 - Use of lipid formulations of amphotericin B may reduce risk.(4)(23)
 - Chemotherapeutics(39)(40)(41)
 - Immunosuppressive medications (eg, cyclosporin)
 - Protease inhibitors (eg, indinavir)
 - NSAIDs
- Monitor therapeutic drug levels of nephrotoxic agents (eg, aminoglycosides, vancomycin).(1)(23)(38)
- ☐ Avoid or minimize use of radiocontrast material.(1)(19)(42)
 - Hold nephrotoxic medications 24 to 48 hours prior to contrast administration.(19)(42)
 - Risk increases with higher volumes of contrast.(1)(4)(42)
 - Encourage hydration (eg, IV fluids) in patients at risk of contrast-induced kidney injury.(1)(4)(42)
- Monitor urine output and evaluate any causes of diminished urine output.(9)
- Provide nutritional support or modified diets (eg, low-sodium diet), if necessary.(3)(4)(43)

Clinical Indications for Ongoing Inpatient Care

- Ongoing inpatient care is indicated for **1 or more** of the following(1)(7)(19):
 - ☐ Acute kidney injury (stage 2) with significant clinical findings, as indicated by **ALL** of the following(4)(19)(44):
 - Acute^[B] kidney injury (stage 2), as indicated by **1 or more** of the following^[C]:
 - Acute^[B] rise in serum creatinine between 2 and 2.9 times its baseline value^[D] (increase of 3 times baseline would qualify as stage 3 acute kidney injury)
 - Decreased urine output,^[E] as indicated by **ALL** of the following:
 - Assessment of urine output appropriate (eg, adequate volume status, no urinary obstruction)
 - Urine output less than 0.5 mL/kg/hr for 12 hours
 - Significant clinical findings, as indicated by **1 or more** of the following^[C]:
 - Hemodynamic instability
 - Worsening clinical status despite observation care (eg, rising creatinine or urine output remains less than 0.5 mL/kg/hr)
 - Altered mental status
 - Cardiac arrhythmias of immediate concern

- Severe hypertension (SBP greater than 180 mm Hg or DBP greater than 120 mm Hg in adults or greater than the 95th percentile for age, gender, and height plus 30 mm Hg in pediatric patients)(45)(46)
- Significant respiratory findings (eg, pulmonary edema) that are severe (eg, Hypoxemia) or persist despite observation care
- Clinically significant electrolyte abnormality that is severe (eg, hyperkalemia with severe ECG findings)[F] or persists despite observation care
- Clinically significant metabolic abnormality (eg, metabolic acidosis) that is severe or persists despite observation care

☐ Acute^[B] kidney injury (stage 3),^[G] as indicated by **1 or more** of the following^[C](4)(19)(44):

- Acute^[B] rise in serum creatinine to 3 times its baseline value^[D] or higher
- Acute^[B] rise in serum creatinine to at least 1.5 times its baseline value^[D] (increase of 50%) and serum creatinine is greater than 4 mg/dL (354 micromoles/L)
- In child younger than 18 years, estimated GFR less than 35 mL/min/1.73m² (0.58 mL/sec/1.73m²)  eGFR - Pediatric Calculator and **1 or more** of the following:
 - Acute^[B] rise in serum creatinine to at least 1.5 times its baseline value^[D] (increase of 50%)
 - Within past 48 hours, rise in serum creatinine greater than 0.3 mg/dL (26.5 micromoles/L)
- Decreased urine output,^[E] as indicated by **ALL** of the following:
 - Assessment of urine output appropriate (eg, adequate volume status, no urinary obstruction)
 - Oligoanuria, as indicated by **1 or more** of the following:
 - Urine output less than 0.3 mL/kg/hr for 24 hours
 - Anuria (urine output less than 0.1 mL/kg/hr) for 12 hours
- Initiation of renal replacement therapy required(49)

☐ Chronic renal insufficiency^[H] and **1 or more** of the following(50)(51)(52):

- Significant uremic findings (eg, pericarditis, pleural effusion, vomiting)(6)(53)
- Severe volume overload (eg, pulmonary edema)(54)
- Hemodynamic instability (4)(7)
- Cardiac arrhythmias of immediate concern (4)(7)
- Altered mental status (53)
- Clinically significant metabolic abnormality (eg, acidosis)
- Clinically significant electrolyte abnormality (eg, hyperkalemia with severe ECG findings)[I](47)
- Infection that requires inpatient care (eg, peritonitis, access site infection not appropriate for outpatient treatment)(52)(55)
- Urgent treatment of renal failure (eg, dialysis) necessary on inpatient basis, as indicated by **1 or more** of the following(56):
 - Vascular access not previously established or not useable (eg, treatment-resistant blockage) such that new temporary access is needed that is not appropriate for other than short-term inpatient usage (eg, femoral access until other access is established or repaired)(57)(58)(59)
 - Patient new to dialysis and timing of subsequent dialysis unclear such that inpatient monitoring is necessary as patient may need repeat dialysis sooner than is routine
- Active management of primary condition requiring frequent therapy adjustments due to changes in renal function (eg, medication dosage changes for medications that are renally metabolized)(23)(38)(60)

Alternatives to Inpatient Care

- Alternatives to inpatient stay extension include:
 - Outpatient care in dialysis center
 - Maintenance or intensification of hemodialysis or peritoneal dialysis[J](61)(62)
 - Home care

- Nursing visit for assessment
- Coordination of outpatient hemodialysis or peritoneal dialysis^{[J](63)}
- Laboratory testing
- IV fluids
- Palliative care⁽⁶⁴⁾⁽⁶⁵⁾
- Recovery facility
 - Nursing assessments
 - Hemodialysis or peritoneal dialysis
 - Laboratory testing
 - IV fluids
 - Palliative care⁽⁶⁴⁾⁽⁶⁵⁾

Discharge

- Extended stay beyond goal length of stay for primary condition may be needed until **ALL** of the following are present:
 - Renal function at baseline or stable and manageable at lower level of care (eg, dialysis not needed or access and plan established)
 - Hemodynamic stability
 - Electrolytes at baseline or acceptable for next level of care
 - Acid-base status at baseline or acceptable for next level of care
 - Mental status at baseline
 - Nausea and vomiting absent or controlled and acceptable for next level of care
 - Pulmonary edema absent or acceptable for next level of care
 - Uremic complications (eg, pericarditis) absent or manageable at lower level of care
 - Diet tolerated
 - Medical comorbidities manageable at lower level of care

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Footnotes

[A] A specialty society guideline and review articles note that clinical decision support systems that interact with laboratory and pharmacy software and that store and update patient history can be helpful in optimizing the care of patients with kidney disease by providing recommendations and order sets specific to preventing

or treating renal failure.(1)(2)(3) [A in Context Link 1]

[B] A specialty society practice guideline defines acute kidney injury as a change in renal function that is known or presumed to have occurred over the previous 7 days.(4) [B in Context Link 1, 2, 3, 4, 5, 6]

[C] In determining the stage of acute kidney injury (eg, stage 2 vs stage 3), patients should be staged according to the criteria that give them the highest stage.(4) [C in Context Link 1, 2, 3]

[D] If the baseline serum creatinine is not known, absent known or suspected chronic kidney disease, a baseline serum creatinine can be approximated by assuming an estimated GFR of 75 mL/min/1.73m² (1.25 mL/sec/1.73m²). (4)  eGFR - Adult Calculator  eGFR - Pediatric Calculator [D in Context Link 1, 2, 3, 4]

[E] The use of urine output as an indicator of acute kidney injury is important, as change in urine output can occur before a noticeable rise in creatinine.(4)(44) It is also suggested that urine output can identify patients with acute kidney injury that may otherwise be missed.(4)(44) However, urine output as a metric is only valid under the appropriate conditions. For example, the patient must not be hypovolemic, there must not be urinary obstruction, and the collection and measurement of urinary output must be complete and accurate.(4)(44) Use of urinary output to define acute kidney injury can be inaccurate in obese patients due to the nonlinear relationship between body weight and urine output. For example, in a 100-kg (220-lb) patient, urine output of 45 mL/hr over 12 hours (adequate output) would qualify as stage 2 acute kidney injury.(4)(44) [E in Context Link 1, 2]

[F] ECG findings include peaked T-waves, PR interval greater than 0.20 seconds, QRS interval greater than 0.12 seconds, and arrhythmia.(47)(48) [F in Context Link 1]

[G] For purposes of these criteria, the term acute renal failure can be viewed as stage 3 acute kidney injury in the KDIGO classification system.(4) Of note, in the ICD-10 diagnostic coding system (main coding scheme used in labeling diagnoses), the relevant codes covering the clinical entity of significant acute kidney injury use the term acute kidney failure (eg, code N17.9). [G in Context Link 1]

[H] A specialty society practice guideline defines chronic renal disease as the presence of reduced kidney function for more than 3 months (ie, estimated GFR of less than 60 mL/min/1.73m² (1.0 mL/sec/1.73m²); albumin excretion rate of 30 mg/24 hours or more; urinary sediment abnormalities; histologic, structural, or tubular disorders; or a history of renal transplant).(5)(50) [H in Context Link 1, 2]

[I] Severe ECG findings include arrhythmias, PR interval greater than 0.20 seconds, and QRS interval greater than 0.12 seconds. Isolated peaked T-waves do not constitute a severe ECG finding.(47) [I in Context Link 1]

[J] Specialty society organizations recommend that all individuals in need of maintenance dialysis have home dialysis available as a treatment option.(61)(62) [J in Context Link 1, 2]

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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Cardiac arrhythmias of immediate concern

- Cardiac arrhythmias or findings of immediate concern, as indicated by **1 or more** of the following(1)(2)(3):
 - Heart rhythms that are inherently dangerous or unstable, as indicated by **1 or more** of the following(4)(5)(6):
 - Resuscitated ventricular fibrillation or cardiac arrest
 - Ventricular escape rhythm
 - Sustained ventricular tachycardia (30 seconds or more of ventricular rhythm at greater than 100 beats per minute)
 - Nonsustained ventricular tachycardia and **1 or more** of the following:
 - Suspected cardiac ischemia as cause or consequence of ventricular tachycardia
 - Acute myocarditis
 - Unstable cardiac conduction defects, as indicated by **1 or more** of the following(7)(8):
 - Type II second-degree atrioventricular block
 - Third-degree atrioventricular block
 - New-onset left bundle branch block with suspected myocardial ischemia(9)
 - Any heart rhythm and **1 or more** of the following(5)(8)(10)(11)(12)(13):
 - Continuous long-term ECG monitoring needed (eg, initiation of drug requiring monitoring beyond observation care)
 - Patient has automatic implantable cardioverter-defibrillator that is repeatedly firing, malfunctioning, or in need of immediate adjustment of settings beyond scope of observation care.
 - Heart rhythms of concern due to **1 or more** of the following(8):
 - Hypotension
 - Respiratory distress
 - Association with other significant symptoms (eg, syncope)(10)(11)

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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)

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. 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)

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.
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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)}

References

1. Schrager 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. Puskarch MA, Jones AE. Shock. In: Walls RM, editor. Rosen's Emergency Medicine: Concepts and Clinical Practice. 10th ed. Elsevier; 2023:34-41.e1.
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.

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)

References

1. Schrager 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. Puskarch MA, Jones AE. Shock. In: Walls RM, editor. Rosen's Emergency Medicine: Concepts and Clinical Practice. 10th ed. Elsevier; 2023:34-41.e1.
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.

Hypoxemia

- Hypoxemia, as indicated by **1 or more** of the following⁽¹⁾:
 - Patient without baseline need for supplemental oxygen with oxygen saturation (SpO₂) of less than 90% or arterial blood gas partial pressure of oxygen (PaO₂) of less than 60 mm Hg (8.0 kPa) on room air^{[A][B]}
 - Patient without baseline need for supplemental oxygen who now requires supplemental oxygen to keep SpO₂ greater than 89% or PaO₂ greater than 59 mm Hg (7.9 kPa)^[A]
 - Patient with baseline need for supplemental oxygen who now requires increased supplemental oxygen to maintain oxygenation at baseline or acceptable level

References

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Footnotes

- A. Pulse oximetry (SpO₂) may underestimate arterial saturation (SaO₂), especially in people with dark skin pigmentation, thick skin, cold body temperature, or who are wearing colored nail polish, and thus may not accurately detect hypoxemia.⁽²⁾ Where appropriate, pulse oximetry should be measured after warming fingers or removing nail polish. Pulse oximetry results should be assessed within the context of the patient's clinical presentation, and performance of an arterial blood

gas considered for a more accurate assessment of oxygenation if indicated.(2) Specific target values may require adjustment when care is delivered at high altitude.(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.

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

References

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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.

Respiratory distress

- Respiratory distress, as indicated by **ALL** of the following(1)(2)(3)(4):
 - Patient with **1 or more** of the following:
 - Dyspnea (difficulty breathing)
 - Tachypnea
 - Abnormal breathing pattern (eg, chest retractions)
 - Other evidence of difficulty breathing
 - Evidence of respiratory compromise, as indicated by **1 or more** of the following:
 - Hypoxemia
 - Altered mental status
 - Other evidence of respiratory compromise (eg, respiratory acidosis)

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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. Schrager 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

- 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.

Tachypnea

- Tachypnea,[A][B] as indicated by **1 or more** of the following:
 - Respiratory rate greater than 20 breaths per minute in adult[A][B](1)
 - Respiratory rate greater than 18 breaths per minute in child 13 to 17 years of age[A][B](2)
 - Respiratory rate greater than 22 breaths per minute in child 6 to 12 years of age[A][B](2)
 - Respiratory rate greater than 25 breaths per minute in child 3 to 5 years of age[A][B](2)
 - Respiratory rate greater than 30 breaths per minute in child 1 or 2 years of age[A][B](2)
 - Respiratory rate greater than 40 breaths per minute in infant 6 to 11 months of age[A][B](2)
 - Respiratory rate greater than 45 breaths per minute in infant 3 to 5 months of age[A][B](2)
 - Respiratory rate greater than 55 breaths 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

- 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 respiratory rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline respiratory rate and whether the respiratory rate is indicative of significant underlying respiratory or other pathology. A mildly increased respiratory rate (eg, 20 to 22 breaths per minute in an adult), absent other indications of serious illness (eg, hypoxemia, metabolic acidosis, decreased tidal volume, pain), may be transitory and not clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachypnea. Whether a respiratory rate above the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment. In addition, the measurement of the respiratory rate is subject to error. A medical textbook states that because there can be significant breath-to-breath variation in respiratory rate, the rate should be assessed for at least 30 seconds, preferably for a full minute.⁽¹⁾ This same textbook also states that new technologies designed to measure the respiratory rate have not proved to be clinically useful.⁽¹⁾

Codes

ICD-10 Diagnosis: E08.22, E09.22, E10.21, E10.22, E10.29, E11.21, E11.22, E11.29, E13.21, E13.22, E13.29, I12.0, I12.9, I13.0, I13.10, I13.11, I13.2, N17.0, N17.1, N17.2, N17.8, N17.9, N18.4, N18.5, N18.6, N18.9, N19, N99.0, O03.32, O03.82, O04.82, O07.32, O08.4, O90.49, T79.5XXA [Hide]

ICD-10 Procedure: 3E1M39Z, 5A1D70Z, 5A1D80Z, 5A1D90Z

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Inpatient & Surgical Care 30th Edition
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Last Update: 1/25/2026 6:33:39 AM
Build Number: 30.0.2026012500524.025256