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Sepsis Management in Adults: Pharmacotherapy Focus

Updated April 2026

The chart below summarizes select pharmacotherapeutic interventions in sepsis/septic shock in adults. This information is mostly based on the Surviving Sepsis Campaign guidelines, available at https://sccm.org/survivingsepsiscampaign/guidelines-and-resources/surviving-sepsis-campaign-adult-guidelines#Recommendations. See **footnote a** for information on screening.

Start immediately and complete within 3 hours of recognition of sepsis or septic shock.

A vasopressor might be indicated (e.g., dangerous organ hypoperfusion). See vasopressor row, below.

FLUIDS | For hypoperfusion or shock (MAP <65 mm Hg, SBP <90 mm Hg [or markedly less than baseline], or lactate >4 mmol/L and perhaps >2 mmol/L)[1]

INTERVENTION/INDICATION	ASSOCIATED TESTING OR MONITORING	COMMENTS
• At least 30 mL/kg of IV crystalloid is suggested.[1] • Balanced crystalloids (e.g., LR, Normosol-R, Plasma-Lyte 148) are generally suggested over NS to potentially decrease risk of hyperchloremic metabolic acidosis, acute kidney injury, and perhaps mortality.[1,2,13] • **Albumin** is suggested for patients who have received large volumes of crystalloids (but confers no mortality benefit) or who have cirrhosis.[1] Avoid in TBI.[1] • It is recommended that starches (e.g., hetastarch) **not** be used in resuscitation, and gelatin is suggested against.[1]	• Serum lactate and capillary refill time within one hour.[1] • Dynamic measures (e.g., passive leg raises or fluid challenge with stroke volume or pulse pressure measurement) are suggested over physical exam, or static measures such as CVP alone.[1] • Capillary refill: suggested adjunct to other perfusion measures.[1]	• Individualize initial volume.[1] • The suggested moderate-volume fixed bolus is based on usual practice and volumes used in the ProCESS, ARISE, and ProMISe studies.[1]In one observational study, 4L (moderate volume) was associated with a 2.5% lower mortality than 1.6 L (very low volume) or 6.1 L (very high volume).[1] • Some experts suggest bolusing in • 500 mL increments per response.[9] • If BMI >30 kg/m^2, use IBW or adjusted body weight.[1] • CVP has limited utility to predict a response to a fluid challenge within the range of 8 to 12 mmHg ("normal").[12]

Start immediately (ideally within one hour) of recognition of possible, probable, or definite septic shock, or probable or definite sepsis without shock. For possible sepsis (without shock), consider a short investigation for infection before starting antimicrobials within three hours from time of first suspicion of sepsis.[1]

ANTIMICROBIALS | For patients with septic shock, start within one hour.[1]

INTERVENTION/INDICATION	ASSOCIATED TESTING OR MONITORING	COMMENTS
• Coverage for **MDR** bacteria (e.g., MRSA, MDR gram negatives):suggested for patients at high risk of MDR bacteria: colonization or infection with an MDR bacteria in the last year, extended stay in a hospital where MDR bacteria are prevalent, or extended use of broad-spectrum antibiotics[1] • **Anaerobic** coverage: consider for patients with high risk of anaerobic infection (e.g., abdominal, deep-seated obstetric/gynecological, head and neck, or necrotizing infections; empyema; abscess)[1] • **Antifungals**: consider for patients with high risk of fungal infection (e.g., immunocompromise, extended hospitalization or antibiotic use, abdominal source).[1] • Optimize dosing based on pharmacodynamics and pharmacokinetics (e.g., for beta-lactams prolonged infusion (after bolus) is recommended).[1]	• **Blood cultures**: draw before starting antimicrobials if it will not cause treatment delay.[1] • **Procalcitonin**: use with clinical evaluation to make treatment duration decisions once source is controlled.[1] • **Pathogen-specific rapid diagnostic tests**: suggested for use in a targeted manner in select (not all) patients, with consideration for clinical features and suspected pathogens, in the context of an antimicrobial stewardship program.[1] • Candida biomarkers can be used as a guide to starting or discontinuing empiric antifungal coverage in patients with high risk of fungal infection.[1]	• Mortality benefit of quick initiation is clearest for shock[1]. • Antibiotics can be started in the ambulance or helicopter for definite or probably septic shock if time to hospital assessment is over an hour.[1] • For patients with a low likelihood of infection (without shock), consider postponing antimicrobials and monitoring closely.[1] • De-escalate when possible (i.e., discontinue antibiotics if an alternate diagnosis is strongly suspected, or narrow the spectrum once the organism is identified).[1] • For bacteremia, seven days of antibiotic treatment is as effective as 14 days.[14]

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Other Interventions

INTERVENTION/INDICATION		ASSOCIATED TESTING OR MONITORING	COMMENTS
Vasopressors For MAP of <65 mmHg during (for unstable shock) or after fluid resuscitation, started peripherally if central access is not already in place.[1]	• Norepinephrine (usually preferred) or epinephrine.[1] • Consider adding vasopressin if response is inadequate to norepinephrine ~0.3 mcg/kg/min.[1] • Epinephrine can be used as an add-on if vasopressin is unavailable.[1]	• Target MAP of 65 mmHg (60 to 70 mm Hg, or 60 to 65 mm Hg if ≥65 years of age), using invasive monitoring if available.[1] • Also monitor perfusion and CO.[1]	• Norepinephrine may be preferred if tachycardia or tachyarrhythmias is a concern; epinephrine may be preferred if bradycardia, bradyarrhythmias, or cardiac dysfunction is of concern.[1] • Epinephrine can increase lactate production, making it hard to use lactate as a monitoring parameter.[1] • Be aware that dobutamine can cause unwanted vasodilatiion and tachycardia.[1] • Starting norepinephrine before or with fluid resuscitation may reduce fluid needs at six hours, cumulative norepinephrine dose, time to target MAP, ventilator days, and mortality [Evidence level B-2].[10]
Inotropic agents For persistent hypoperfusion and cardiac dysfunction despite adequate volume and MAP.[1]	• Epinephrine is suggested in place of norepinephrine.[1] • Dobutamine can be added to norepinephrine.[1]		
Midodrine For patients with ongoing need for vasopressors.	• Consider 10 mg every 8 hours.[21]	NA	• Most often used in stable patients to assist with vasopressor weaning.[1] Less commonly used to avoid starting vasopressors in mild shock.[1]
VTE Prophylaxis For patients with sepsis or septic shock.[1]	• LMWH (preferred) or UFH is recommended, unless contraindicated.[1] • Use mechanical prophylaxis if pharmacologic prophylaxis is contraindicated.[1]	NA	• Dalteparin (Fragmin) or UFH is preferred if CrCl <30 mL/min.[15] • There is no clear benefit of combining pharmacologic with nonpharmacologic prophylaxis.[1]
Insulin Glucose level ≥180 mg/dL (10 mmol/L).[1]	• Use an insulin infusion in critically ill patients.[6]	• Target glucose 140 to 200 mg/dL (7.8 to 11.1 mmol/L).[6] • Monitor glucose continuously or at least hourly while glucose levels are unstable.[6]	• Glucose targets were chosen to minimize the risk of hypoglycemia.[6]
Sodium bicarbonate Suggested for septic shock with blood pH ≤7.2, and AKIN score 2 or 3.[1]	• Consider sodium bicarbonate 4.2%, 125 to 250 mL over 30 min. Max 1,000 mL within 24 hours.[4]	• Target arterial pH ≥7.3.[4]	• Guidelines suggest against use for lactic acidemia due to hypoperfusion, to improve hemodynamics or to reduce vasopressor needs.[1] • Does not seem to reduce mortality, but is associated with lower use of KRT [Evidence level B-1].[4]
Stress Ulcer Prophylaxis Suggested for patients with risk factors for GI bleed.[1]	• Proton pump inhibitors preferred.[1]	NA	• Proton pump inhibitors pose a higher risk of *Clostridioides difficile* colitis than H2 blockers. Limiting use to 14 days may mitigate risk[16]
Corticosteroids Suggested for septic shock[1]	• Consider hydrocortisone 50 mg IV every six hours (most commonly) or 200 mg/day as a continuous infusion.[1,7] In the largest RCT (ADRENAL), duration was 7 days.[1] • Can also add fludrocortisone • 50 mcg x 7 days or until ICU discharge.[7]	• Cortisol and ACTH are not useful to help determine which septic patients will respond to steroids.[15]	• Corticosteroids have small to moderate benefits on LOS, mortality, shock duration, and organ function.[1,7] • Continuous infusion preferred over boluses to minimize hyperglycemia.[15]
Blood Transfuse when hemoglobin <7 g/dL (or higher in extenuating circumstances [e.g., ACS, hemorrhage, etc]).[11]	NA	• Hemoglobin	• Recommendation based on the TRISS, TRICC, and TRICOP studies.[11]
Vitamin C Suggested **against** in current guidelines.[1]	• 50 mg/kg in 50 mL D5W every six hours for 96 hours has been used.[5]	NA	• No effect on mortality.[1] • Any benefit on duration of vasopressor use is very small.[1]
Methylene blue Sometimes used as rescue therapy for hypotension refractory to vasopressors.[1]	• 1 to 2 mg/kg in 50 mL D5W infused over 5 to 30 minutes.[1,19] May repeat after one hour if needed.[1]	MAP	• Not proven to improve survival.[1] • Increases vascular tone by inhibiting nitric oxide synthase and soluble guanylate cyclase.[1]
Selective decontamination of GI tract Suggested in mechanically ventilated patients with sepsis or septic shock if unit has a low prevalence of antimicrobial resistance.	• Typically, tobramycin, colistin, and amphotericin B or nystatin are administered topically in the oropharynx as a suspension and oral paste every six hours, plus a short-course (e.g., four-days) of a broad spectrum IV antibiotic (e.g., third-generation cephalosporin).[1,17,18] • Suspension and oral paste must be compounded.	• Consider monitoring trough tobramycin levels and reducing the dose if level is >1 mg/L.[20]	• May reduce mortality by reducing ventilator-associated pneumonia and bacteremia.[1] • Does not seem to increase antimicrobial resistance.[1]

a. **Screening**: Suspect sepsis in acutely ill, high-risk patients.[1] Screening can event be done in the ambulance or helicopter.[1] Tools include SIRS criteria, NEWS, NEW2, or MEWS.[1] One of the EWS variants may be the most clinically useful.[8] qSOFA should not be used alone due to poor sensitivity.[1] A blood lactate level is also suggested.[1]

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Abbreviations: ACTH = adrenocorticotrophic hormone; ACS = acute coronary syndrome; AKIN = Acute Kidney Injury Network; BMI = body mass index; CO = cardiac output; CVP = central venous pressure; EWS = Early Warning Score; GI = gastrointestinal; IBW = ideal body weight; ICU = intensive care unit; KRT = kidney replacement therapy; LMWH = low-molecular-weight heparin; LOS = length of stay; IV = intravenous; LR = Lactated Ringer's; MAP = mean arterial pressure; MDR = multidrug resistant; MEWS = Modified Early Warning Score; MRSA = methicillin-resistant Staphylococcus aureus; NA = not applicable; NEWS = National Early Warning Score; NS = normal saline; SBP = systolic blood pressure; SIRS = systemic inflammatory response syndrome; qSOFA = quick Sequential Organ Failure Assessment; SV = stroke volume; TBI = traumatic brain injury; UFH = unfractionated heparin; VTE = venous thromboembolism

Levels of Evidence

Level	Definition	Study Quality
A	Good-quality patient-oriented evidence.*	1.High-quality randomized controlled trial (RCT) 2.Systematic review (SR)/Meta-analysis of RCTs with consistent findings 3.All-or-none study
B	Inconsistent or limited-quality patient-oriented evidence.*	1.Lower-quality RCT 2.SR/Meta-analysis with low-quality clinical trials or of studies with inconsistent findings 3.Cohort study 4.Case control study
C	Consensus; usual practice; expert opinion; disease-oriented evidence (e.g., physiologic or surrogate endpoints); case series for studies of diagnosis, treatment, prevention, or screening.	

*Outcomes that matter to patients (e.g., morbidity, mortality, symptom improvement, quality of life).
[Adapted from Ebell MH, Siwek J, Weiss BD, et al. Strength of Recommendation Taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. Am Fam Physician 2004;69:548-56. https://www.aafp.org/pubs/afp/issues/2004/0201/p548.html.]

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Vasopressors for Shock

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The first chart below addresses choice of vasopressor for different shock states. For dosing and additional drug information (e.g., pharmacology), see the second chart, below.
Interactive note: Roll over **blue text** to view additional information.

Clinical Scenario	Preferred Vasopressors
Cardiogenic shock	• Initial vasopressor choice depends on whether patient is hypotensive or normotensive.[1] • If hypotensive (e.g., MAP ≤65 mmHg, SBP <90 mmHg, evidence of hypoperfusion):[1] » Start with **norepinephrine**.[1] » Add **doB**utamine or **milrinone** to address low CO.[1] • If blood pressure is preserved, but CO is low:[1] » Start with **doB**utamine or **milrinone**.[1] » Add **norepinephrine** if hypotension develops.[1] • For persistent hypotension, consider vasopressin.[1] • **Special situations**: aortic regurgitation (norepinephrine or epinephrine), aortic stenosis (norepinephrine [phenylephrine if systolic function is preserved]), mitral stenosis (phenylephrine +/- vasopressin).[29]
Septic shock	• **Norepinephrine** (first-line).[4] » If norepinephrine is not available, consider **epinephrine** or **doP**amine.[4] • Consider adding **vasopressin** if MAP target (65 mmHg) not achieved with norepinephrine 0.25 to 0.5 mcg/kg/min.[4] • Consider adding epinephrine for refractory hypotension.[4] • **Angiotensin II** could be used as an adjunct in refractory shock or to limit norepinephrine dose.[4,5] » Based on study population, consider for patients who are hypotensive despite fluid and pressors (e.g., NE, vasopressin, EPI) at a median "NE equivalent" dose of 0.33 mcg/kg/min.[6] • For cardiac dysfunction and hypoperfusion after optimization of volume and MAP, consider **adding doB**utamine to norepinephrine, or **switching to epinephrine alone**.[4] • See our chart, *Sepsis Management in Adults: Pharmacotherapy Focus*, for more information.
Anaphylactic shock	• Epinephrine[3] • Angiotensin II (adjunct[7,8]) » FDA-approved for distributive shock, but most patients in the major clinical trial had septic shock.[6,7]

Drug	Dosing (also see footnotes a and b)	Comments/Pharmacology
Angiotensin II (*Giapreza*)	• Note that dosing is in **NANO**grams/kg/min. • See product information for dosing.	• Causes vasoconstriction and aldosterone release.[7] • May reduce mortality in certain patient subsets (e.g., patients with acute kidney injury requiring kidney replacement therapy or higher renin concentrations).[5] • Has not been studied first-line or compared to other add-on pressors. • Consider for distributive shock refractory to vasopressin or epinephrine.[20]
DoButamine	• Initial 2.5 to 5 mcg/kg/min.[13] • Titration 2.5 to 5 mcg/kg/min every 5 to 15 min.[13] • Max 20 mcg/kg/min.[9]	• Clinical effects depend on dose and baseline physiologic state.[4,13] • Less arrhythmogenic than dopamine.[11] • Tolerance may develop, necessitating dosage increase to get the same effect.[12]
DoPamine	• Initial 2 to 5 mcg/kg/min.[2] • Titration 2 to 5 mcg/kg/min every 5 to 15 minutes.[13] • Max 20 mcg/kg/min.[13] • Septic shock (range) 2 mcg/kg/min to 20 mcg/kg/min)	• Associated with higher risk of arrhythmia and death in septic and cardiogenic shock vs. NE.[1,4,9] • Higher risk of tachycardia and arrhythmias compared to doButamine, milrinone, or EPI.[13] • Beta-1 activity may be useful to increase CO, but arrhythmia risk limits use.[4] • Pharmacologic effects are dose-dependent.
Epinephrine	• Initial 0.02 to 0.05 mcg/kg/min.[13] • Titration 0.02 to 0.05 mcg/kg/min every 5 to 15 min.[13] • **Septic shock** (usual dose) 0.1 to 0.3 mcg/kg/min.[28] • **Cardiogenic shock** (usual dose) 0.01 to 0.5 mcg/kg/min.[9] • **Anaphylactic shock** 5 to 15 mcg/min.[14]	• A continuous infusion is recommended for anaphylaxis refractory to two intermittent EPI doses (IM or IV) and fluid resuscitation.[3,10] • Has more beta-agonist activity than norepinephrine.[20] • Pharmacologic effects are dose-dependent. • EPI impairs splanchnic perfusion compared to NE or dopamine.[13] • Increases glucose.[15] • EPI can increase lactate levels.[15] Due to downregulation of beta-1 receptors, EPI effect on lactate diminishes after 12 hours.[15]

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Vasopressors for Shock

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Drug	Dosing (also see footnotes a and b)	Comments/Pharmacology
Midodrine	• Initial 10 mg every 8 hours.[24] • Titration 10 mg/dose.[26] • Max 40 mg every 8 hours.[26] • Decrease by 5 to 10 mg/day if BP stays at goal off vasopressor for 24 hours.[26]	• Alpha-1 agonist.[27] Increases BP.[27] May cause reflex bradycardia.[27] • Used to help discontinue IV vasopressors.
Milrinone	• Usual dose 0.125 to 0.75mcg/kg/min.[9] • Sometimes a 50 mg/kg bolus is given, but may cause hypotension.[9,13]	• Phosphodiesterase-3 inhibitor.[13] Increases CO, decreases SVR.[9] • Reduces SVR, PVR, and PCWP more than doButamine.[9,13] » More likely to cause hypotension than doButamine.[13] • Lower risk of tachycardia and arrythmias than doButamine.[13] • Consider over dobutamine in patients who have recently received a beta-blocker.[13] • Longer half-life than dobutamine, so harder to titrate.[13] • Requires renal dose reduction in kidney impairment.[13]
Norepinephrine	• Initial 0.01 to 0.04 mcg/kg/min.[13] • Titration 0.02 to 0.04 mcg/kg/min every 5 to 15 min.[13] • **Septic shock** (range) 0.02 to 0.19 mcg/kg/min.[16] • **Cardiogenic shock** (usual dose) 0.05 to 0.4 mcg/kg/min.[9]	• **For septic shock**: » Consider adding another pressor when dose nears 0.3 mcg/kg/min.[4,17] » Doses ≥1 mcg/kg/min are associated with higher mortality.[30] • Predominately an alpha agonist.[13] Increases SVR and MAP.[1,4] • Some beta-1 agonist effect, which increases CO.[13] Little effect on HR except at high doses.[4,13] • Lower risk of tachyarrhythmias than doPamine or EPI.[13] • Associated with lower risk of arrhythmia and death in septic and cardiogenic shock compared to **doP**amine.[1,4,9]
Phenylephrine	• Initial 0.1 to 0.3 mcg/kg/min.[13] • Titration 0.1 to 0.4 mcg/kg/min every 5 to 15 min.[13] • Cardiogenic shock (usual dose), 0.1 to 10 mcg/kg/min.[9]	• Alpha-1 agonist.[13] Increases SVR and MAP.[13] • Can reduce CO and HR (due to increased afterload and reflex bradycardia).[1,13,18] • In septic shock, associated with higher mortality than NE.[20] • Consider a max of 1.5 to 2 mcg/kg/min to limit tissue ischemia.[13] • No survival advantage vs NE for septic shock.[19] • Consider for distributive shock refractory to NE, vasopressin, or EPI.[20]
Vasopressin	• **Septic shock**, 0.03 units/min (fixed dose).[4] • **Cardiogenic shock** (usual dose), 0.02 to 0.04 units/min.[9]	• A vasoconstrictor.[20] • In **septic shock**, dose can be increased to 0.06 units/min., but ischemic risk may be > benefit.[4,13,21] • For **septic shock**, consider starting when NE dose reaches 0.25 to 0.5 mcg/kg/min for NE-sparing effect to reduce tachycardia and arrhythmias [Evidence Level A-1].[4,20,21] • Limited data suggest vasopressin use may be associated with lower mortality in septic shock at 90 days.[20] • Reduces risk of atrial fibrillation when used with a catecholamine vasopressor (e.g., NE) in **distributive shock**.[22] • No outcomes data in cardiogenic shock. • Consider the patient's dose and use an appropriate bag size to minimize waste.

Abbreviations: BP = blood pressure; CO = cardiac output; EPI = epinephrine; HR = heart rate; MAP = mean arterial pressure; NE = norepinephrine; PCWP = pulmonary capillary wedge pressure; PVR = pulmonary vascular resistance; SBP = systolic blood pressure; SVR = systemic vascular resistance

Footnotes:

a. **Goals** of therapy for shock: achieve and maintain adequate tissue perfusion.[9] Consider a MAP target of 65 mmHg in adults based on data from other populations (recommended in septic shock).[4,9] Balance MAP target with vasopressor side effects (e.g., arrhythmias, myocardial ischemia).[9] Some markers to consider include lactate, mixed or central venous oxygen saturation, urine output, serum creatinine, liver function tests, cognitive function, and temperature.[4,9,20] Individualize targets.[9]

b. **Dosing**. Doses are variable and not well-defined for most indications. Assess and correct volume status before using IV vasopressors.[20] To minimize side effects (e.g., myocardial or other organ ischemia, arrhythmias), use vasopressors for the shortest time at the lowest dose necessary to maintain organ function.[13,25]

Vasopressors for Shock

Updated February 2025

Levels of Evidence:
In accordance with our goal of providing Evidence-Based information, we are citing the **LEVEL OF EVIDENCE** for the clinical recommendations we publish.

Level	Definition	Study Quality
A	Good-quality patient-oriented evidence.*	1. High-quality randomized controlled trial (RCT) 2. Systematic review (SR)/Meta-analysis of RCTs with consistent findings 3. All-or-none study
B	Inconsistent or limited-quality patient-oriented evidence.*	1. Lower-quality RCT 2. SR/Meta-analysis with low-quality clinical trials or of studies with inconsistent findings 3. Cohort study 4. Case control study
C	Consensus; usual practice; expert opinion; disease-oriented evidence (e.g., physiologic or surrogate endpoints); case series for studies of diagnosis, treatment, prevention, or screening.	

***Outcomes that matter to patients** (e.g., morbidity, mortality, symptom improvement, quality of life).
[Adapted from Ebell MH, Siwek J, Weiss BD, et al. Strength of Recommendation Taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. Am Fam Physician 2004;69:548-56.
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Users of this resource are cautioned to use their own professional judgment and consult any other necessary or appropriate sources prior to making clinical judgments based on the content of this document. Our editors have researched the information with input from experts, government agencies, and national organizations. Information and internet links in this article were current as of the date of publication.

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Antimicrobial Stewardship

full update February 2026

Thirty percent of antibiotic courses prescribed in US hospitals are inappropriate.[18] Inappropriate antibiotic use contributes to the development of bacterial resistance.[18] Resistance is increasing faster than new antibiotics can be developed, threatening the ability to treat certain infections.[23] Each year, almost three million people in the US become infected with an antibiotic-resistant pathogen leading to more than 35,000 deaths.[18] Antimicrobial stewardship is a set of coordinated strategies to optimize and measure antimicrobial use to improve patient safety and outcomes, limit antimicrobial resistance, and decrease unnecessary costs.[23] This toolbox provides information and resources to reduce infections and optimize the use of antibiotics.

Goal	Suggested Strategies or Resources

Learn about antimicrobial stewardship from available resources.	• Resources from the **CDC** (educational resources, training opportunities):
	  ○ Antibiotic stewardship training (continuing education): https://www.cdc.gov/antibiotic-use/hcp/training/.
	  ○ Core Elements of Antibiotic Stewardship: https://www.cdc.gov/antibiotic-use/hcp/core-elements/index.html.
	  ○ Core Elements of Hospital Antibiotic Stewardship Programs: https://www.cdc.gov/antibiotic-use/hcp/core-elements/hospital.html. Contains information on pharmacist involvement.
	  ○ Core Elements of Outpatient Antibiotic Stewardship: https://www.cdc.gov/antibiotic-use/hcp/core-elements/outpatient-antibiotic-stewardship.html
	  ○ Core Elements of Antibiotic Stewardship for Nursing Homes: https://www.cdc.gov/antibiotic-use/hcp/core-elements/nursing-homes-antibiotic-stewardship.html
	  ○ Antibiotic Stewardship Resource Bundles (educational resources for outpatient, dental, nursing home, acute care, and transitions of care; includes patient information materials: https://www.cdc.gov/antibiotic-use/hcp/educational-resources/stewardship/
	• The **Agency for Healthcare Research and Quality** has a *Toolkit to Improve Antibiotic Use in Acute Care Hospitals* at https://www.ahrq.gov/antibiotic-use/acute-care/index.html
	• See evidence-based guidelines from the **IDSA** on developing an antimicrobial stewardship program at https://academic.oup.com/cid/article/62/10/e51/2462846?searchresult=1
	• The **American Hospital Association** has tips for interdisciplinary collaboration, nursing resources, and more at https://www.aha.org/antibiotic-stewardship
	• See a compilation of resources from the **Association for Professionals in Infection Control and Epidemiology** at https://apic.org/professional-practice/antimicrobial-stewardship/

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Goal	Suggested Strategies or Resources
Take steps to develop and improve your antimicrobial stewardship program.	• **Choose your program's multidisciplinary team** (optimally an infectious diseases pharmacist and/or infectious diseases physician as the leader, clinical microbiologist, information system specialist, hospital epidemiologist, infection control professional, and representative from nursing and quality assessment and performance), with at least one member having formal antimicrobial stewardship training.[36-38] • **Establish goals and objectives** (e.g., improve patient safety and outcomes, manage resistance, prevent selection of pathogenic organisms such as *Clostridioides difficile*, reduce costs).[37] • **Define key outcome measures** (e.g., antibiotic use, *Clostridioides difficile* infections, resistance, cost) and process measures (e.g., acceptance of recommendations, timeliness of preauthorization, guideline adherence).[18] • **Educate prescribers, pharmacists, and nurses** about antibiotic resistance, adverse effects, and optimal prescribing.[18] (**See resources in this document**). o Case-based education is especially effective.[18] o Pair education with prospective audit and feedback.[18] • **Determine monitoring methods** for antibiotic prescribing, the impact of interventions, and outcomes.[18] • **Develop your antibiogram**. The Clinical Laboratory Standards Institute offers an on-demand webinar about antibiogram preparation and use (https://clsi.org/standards/products/microbiology/education/m39ed5wr/). • **Develop facility-specific treatment guidelines**.[18] • Work with your hospital to implement policies for restricting broad spectrum antibiotics to certain prescribers or indications. • **Work with information technology** to utilize electronic health record features to facilitate your initiatives (e.g., include decision support and relevant information at order entry, facilitate NHSN AUR reporting [see below]).[18] • **Develop processes for prospective audit with feedback**, or preauthorization, to improve antibiotic use.[18] • **Plan how antibiotic utilization and resistance data will be reported** to prescribers, pharmacists, nurses, and administrators.[18] • **Ensure you have all the core elements** (see https://www.cdc.gov/antibiotic-use/hcp/core-elements/hospital.html).
Educate yourself and your colleagues with available resources.	• The **CDC**'s *Be Antibiotics Aware* educational effort complements the US Antibiotic Awareness Week. A toolkit with key messages for healthcare professionals, and reproducible social media posts and newsletter content, is available at https://www.cdc.gov/antibiotic-use/php/usaaw-partner-toolkit/. • Additional **CDC** *Educational Materials for Healthcare Providers* are available at https://www.cdc.gov/antibiotic-use/hcp/educational-resources/index.html. In addition to resources for educating prescribers (including dentists), pharmacists, and patients, there is a "return to daycare" letter, and prescriptions for watchful waiting. • Visit **AMR Aware Canada** at https://antibioticawareness.ca/ for patient and provider information, videos, factsheets, and treatment guidelines.

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Goal	Suggested Strategies or Resources
Continued… Educate yourself and your colleagues with available resources, continued	• The **Choosing Wisely** campaign aimed to promote conversations between prescribers and patients about treatments, tests, and procedures that might not be appropriate. Antibiotic- related topics include: o Otitis Media (American Academy of Family Physicians): https://www.aafp.org/family-physician/patient-care/clinical-recommendations/all-clinical-recommendations/cw-otitis-media.html. o Sinusitis (American Academy of Family Physicians): https://www.aafp.org/family-physician/patient-care/clinical-recommendations/all-clinical-recommendations/cw-sinusitis.html. o Using Antibiotics Wisely (Canada): https://choosingwiselycanada.org/primary-care/antibiotics/. • *Do Bugs Need Drugs?* (**Alberta Health**) is a community program promoting the wise use of antibiotics. Notable features include a long-term care urine testing algorithm, and antibiotic prescribing guides (including dosing). See http://www.dobugsneeddrugs.org. • A training module for talking with patients about antibiotics during a primary care office visit is available at https://www.empr.com/home/features/conversations-for-health-an-innovative-educational-tool-for-reducing-antibiotic-overuse/. • Know when and how to use newer antibiotics or antibiotics that may be increasingly used due to resistance. • Remind colleagues of the significance of antibiotic misuse. For example, taking a prescribed antibiotic was shown to increase resistant bacteria in a patient's urinary and respiratory tracts with a peak incidence at one month, and some still present at 12 months.[9] • Use these resources to help with appropriate outpatient antibiotic selection: o Outpatient Clinical Care for Adults: https://www.cdc.gov/antibiotic-use/hcp/clinical-care/adult-outpatient.html o Outpatient Clinical Care for Pediatric Populations. https://www.cdc.gov/antibiotic-use/hcp/clinical-care/pediatric-outpatient.html
Access resources related to accreditation (US).	• **Joint Commission**, New and Revised Antibiotic Stewardship Requirements: o Standards FAQ: What are the expectations for a hospital's antibiotic stewardship program? https://www.jointcommission.org/en-us/knowledge-library/support-center/standards-interpretation/standards-faqs/000002449 • **NIAHO** (National Integrated Accreditation for Healthcare Organizations): https://brandcentral.dnvgl.com/original/gallery/dnvgl/files/original/ecd238b80cbd46c9addf668e7e8c55b0.pdf • The **CDC**'s National Healthcare Safety Network (NHSN) (https://www.cdc.gov/nhsn/index.html) is used to comply with Centers for Medicare and Medicaid Services infection reporting requirements.[35] Its Antimicrobial Use and Resistance (AUR) Options feature (https://www.cdc.gov/nhsn/psc/aur/index.html) offers many resources and allows data from your institution's electronic medication administration record and/or laboratory information system, to be benchmarked with others. Antibiotic use data are shared to help you identify areas for improvement.[22]

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Goal	Suggested Strategies or Resources
Develop evidence-based antibiotic guidelines.	**Use these resources to help develop facility-specific treatment guidelines (**may be required to meet US accreditation requirements).[23] **Endocarditis** • American Heart Association Scientific Statement (endorsed by IDSA) on infective endocarditis in adults: https://www.idsociety.org/globalassets/idsa/practice-guidelines/infective-endocarditis-in-adults-diagnosis-antimicrobial-therapy-and-management-of-complications.pdf. • European Society of Cardiology guidelines for the management of infective endocarditis: https://academic.oup.com/eurheartj/article/44/39/3948/7243107 **Gastrointestinal Infections** • Use our FAQ, *Acute Infectious Diarrhea*, to review appropriate antibiotic use for acute infectious diarrhea. • See resources for *Clostridioides difficile* below. **Abdominal Infections** • IDSA guidelines: https://www.idsociety.org/practice-guideline/intra-abdominal-infections/ • SIS guidelines: https://sisna.org/the-surgical-infection-society-guidelines-on-the-management-of-intra-abdominal-infection-2024-update/ **MRSA** • FAQ, *Vancomycin Dosing and Monitoring in Adults*. **Osteomyelitis** • Chart, *Oral Antibiotics for Acute Osteomyelitis in Adults*. **Respiratory Infections** • FAQ: *Managing Community-Acquired Pneumonia and Aspiration Pneumonia in Adults.* • FAQ: *Hospital-Acquired and Ventilator-Associated Pneumonia.* • Algorithm: *Improving COPD Care*. • FAQ: *Acute Otitis Media.* **Sepsis** • Chart, *Sepsis Management in Adults: Pharmacotherapy Focus*. **Skin and Soft Tissue Infections** • Chart. *Skin and Soft Tissue Infections*.
Continued…	

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Goal	Suggested Strategies or Resources
Develop evidence-based antibiotic guidelines, continued	• From IDSA, see Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update at https://www.idsociety.org/practice-guideline/skin-and-soft-tissue-infections/. **Urinary Tract Infections** • Infographic, *Urinary Tract Infections*. • FAQ, *Bacterial Prostatitis*.

Recognize opportunities to avoid or limit systemic antibiotic use.	• See our chart, *Antibiotic Therapy: When Are Shorter Courses Better?*
	• Otitis externa: treat uncomplicated otitis externa (swimmer's ear) with topical antibiotics rather than oral antibiotics to minimize resistance. See our chart, *Prevention and Treatment of Swimmer's Ear*.
	• Pharyngitis: antibiotic treatment has no proven benefit except for Group A Streptococcus (strep throat), diphtheria, and gonorrhea.[24] Use a scoring system to help identify which patients should be tested and treated for strep throat.[24]
	• Sinusitis: most cases of sinusitis are caused by viruses.[27] Consider two to three days of watchful waiting before prescribing an antibiotic.[27]
	• Urine cultures are not needed in most patients who do not have urinary symptoms.[34,40] Develop a urine culture stewardship program in your facility.[34]
	• Acute bronchitis, most coughs, and gastroenteritis are usually caused by viruses.[8,28]
	• Antibiotics may not be appropriate for all cases of acute pancreatitis. See our FAQ, *Pancreatitis*, for details.
	• Recognize reasons for overdiagnosis of acute bacterial respiratory infections:[25]
	  o Diagnostic uncertainty. Set up a contingency plan to counter this.
	  o Perceived patient expectation for an antibiotic.
	  o See "Address patient demand for an antibiotic" and "Proactively manage patient expectations for an antibiotic" sections for countermeasures.
	• Discontinue antimicrobials when appropriate. For example, a patient with uncomplicated *Enterococcus* bacteremia from a removed catheter line may be treated for as little as five to seven days with IV; switching to oral is not needed.[19]

Prevent and treat *Clostridioides* (*Clostridium) difficile* infections	• Improving infection control and antibiotic prescribing could save 37,000 lives over five years by affecting healthcare-associated *C. difficile* infections.[14]
	• Reducing *C. difficile* infections should be a high priority goal for all antimicrobial stewardship programs.[23]
	  o See our FAQ, *Clostridioides* (*Clostridium) difficile in Adults*.
	  o Find educational resources for healthcare professionals and the general public at https://www.cdc.gov/c-diff/.
	  o Find more information in the IDSA/SHEA 2021guidelines on management of C. difficile in adults at https://academic.oup.com/cid/article/73/5/e1029/6298219.

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Goal	Suggested Strategies or Resources
Appropriately treat acne to limit resistance.	• Limit duration of oral antibiotics for **acne** (e.g., three to four months).[4,6] Combine topical antibiotics with topical benzoyl peroxide, and avoid oral antibiotic monotherapy to help limit development of resistant organisms.[4,6] o See our chart, *Pharmacotherapy of Acne*.
Prevent central line and surgical site infections.	• Use appropriate antibiotic prophylaxis in surgery to help reduce the risk of surgical site infections. o See *Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery* from ASHP, IDSA, SIS, and SHEA at https://www.ashp.org/surgical-guidelines o See the WHO's *Global Guidelines for the Prevention of Surgical Site Infection* for information on antibiotic timing, duration of therapy, and use of intranasal mupirocin at https://www.who.int/publications/i/item/9789241550475. • See the CDC's *Checklist for Prevention of Central Line Associated Blood Stream Infections* at https://www.cdc.gov/healthcare-associated-infections/media/pdfs/checklist-for-CLABSI-P.pdf.
Use testing to limit inappropriate antibiotic use.	• Use rapid identification tests to facilitate your antimicrobial stewardship initiatives (i.e., to distinguish viral vs bacterial etiologies, identify bacterial pathogens, determine susceptibilities), with active support for interpretation and response.[23,38] • Procalcitonin testing, in conjunction with clinical judgment, can help support the decision to discontinue antibiotic therapy in hospital- or ventilator-associated pneumonia.[17] • Consider offering point-of-care tests in the pharmacy to evaluate whether antibiotics are necessary (e.g., influenza, strep, COVID-19).[33]
Be aware of special considerations in pediatric patients.	• Be aware that resistance rates for some bacteria may be different from adults (e.g., *E. coli*).[3] • Be familiar with conditions requiring higher than typical antibiotic doses (e.g., cystic fibrosis, pediatric bone and joint infections). o Work with information technology to ensure max dose caps are updated to prevent weight-based doses in bigger kids (e.g., 50 kg) from exceeding maximum recommended antibiotic doses.[26] o Find antibiotic **dosing** guidance from: ▪ Cystic Fibrosis o The American Thoracic Society: https://www.atsjournals.org/doi/full/10.1513/AnnalsATS.201402-050AS. o Cystic Fibrosis Canada: at https://cystic-fibrosis.cdn.prismic.io/cystic-fibrosis/aWp3wAIvOtkhBqJe_FinalAntibioticDosingGuidelines-2025.pdf. ▪ Bone and Joint Infections o PIDS/IDSA (acute bacterial arthritis): https://www.idsociety.org/practice-guideline/acute-bacterial-arthritis-in-pediatrics2/ o PIDS/IDSA (acute hematogenous osteomyelitis): https://www.idsociety.org/practice-guideline/bone-and-joint-infections---osteomyelitis/ o European Society for Paediatric Infectious Diseases: https://www.espid.org//data/files/Guideline%20Sub-Committee/OD-ESPID-17%20Bone%20and%20Joint%20Infections%20ESPID%20guidelines.pdf.

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Goal	Suggested Strategies or Resources
Be aware of special considerations in pediatric patients, continued	○ Canadian Paediatric Society: https://cps.ca/en/documents/position/osteoarticular-infections-in-children. • Consider observation over immediately prescribing empiric antibiotics in newborns at low risk of early onset sepsis.[13] Consider using the Kaiser Permanente neonatal early-onset sepsis calculator at https://neonatalsepsiscalculator.kaiserpermanente.org/. • Avoid unnecessary antibiotic use. See the row titled "Identify infections at risk of antibiotic overuse." • See the Canadian Paediatric Society's *Antimicrobial Stewardship in Daily Practice: Managing an Important Resource* at https://cps.ca/en/documents/position/antimicrobial-stewardship.
Limit adverse drug reactions associated with antibiotics.	• Help patients avoid potential drug interactions by asking about their use of over-the-counter meds and supplements. • Counsel patients on ways to minimize antibiotic adverse effects (e.g., take nitrofurantoin with food; take clindamycin with a full glass of water).[1] • Recognize antibiotics that can cause QT prolongation (e.g., macrolides, quinolones) and at-risk patients.[1] • Clarify whether a patient's history of drug allergy necessitates a broader spectrum antibiotic. Resources include: ○ our FAQ, *Managing Beta-Lactam Allergies*. ○ our algorithm, *Investigating Possible Drug Allergy*. ○ CDC resource for community pharmacists, Verify Penicillin Allergy at https://www.cdc.gov/antibiotic-use/media/pdfs/Community-Penicillin-Allergy-Poster-508.pdf. • Choose appropriate antibiotics during pregnancy and lactation.
Target bacteria at high risk of developing antibiotic resistance.	• Become familiar with the details on national plans, strategies, and solutions: ○ US National Action Plan for Combating Antibiotic-Resistant Bacteria at https://aspe.hhs.gov/reports/national-action-plan-combating-antibiotic-resistant-bacteria-2020-2025. ○ Pan-Canadian Action Plan on Antimicrobial Resistance at https://www.canada.ca/en/public-health/services/publications/drugs-health-products/pan-canadian-action-plan-antimicrobial-resistance.html. • The US National Action Plan specifically mentions these worrisome trends:[5] ○ the discovery of new resistant pathogens (e.g., *Candida auris*). ○ an increase in community-acquired drug-resistant group A Strep infection. ○ community-acquired infections with extended-spectrum beta-lactamase-producing Enterobacterales. ○ an increase in resistant *Neisseria gonorrhoeae* infections. • See the CDC's *Carbapenem-Resistant Enterobacterales (CRE) Infection Control* for information on transferring patients with CRE, testing, and isolation guidance at https://www.cdc.gov/cre/hcp/infection-control/?CDC_AAref_Val=https://www.cdc.gov/hai/organisms/cre/cre-facilities.html. • See our FAQ, *Resistant Gram-Negative Bacterial Infections*.

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Goal	Suggested Strategies or Resources
Use vaccines to prevent infection.	**Influenza** • Our FAQ, *Communicating About Flu Vaccination*, answers questions about efficacy, administration with other vaccines, use in immunocompromised or pregnant patients, and more. • Use our chart, *Flu Vaccines* (US)(Canada) to choose the best vaccine for patients. • Public education materials about flu vaccination are available from the CDC (e.g., *Seasonal Flu Vaccine Basics* https://www.cdc.gov/flu/vaccines/index.html) and Health Canada (e.g., *Flu (seasonal influenza): Get Your Flu Vaccine* (*flu shot*) [https://www.canada.ca/en/public-health/services/diseases/flu-influenza/get-your-flu-shot.html]). **Pneumonia** • See our algorithm, *Pneumococcal Vaccination in Adults*. **COVID-19** • Use our chart, *COVID-19 Vaccines* (US)(Canada) to choose the most appropriate vaccine for patients. o The chart includes a "frequently asked questions" section to help address misconceptions. **Other immunization** resources: o Our FAQ, *Vaccinating Immunocompromised Patients*. o Our checklist, *Vaccine Adherence: Addressing Myths and Hesitancy*.
Educate patients on infection prevention.	• Teach patients simple ways to prevent spreading germs: o Avoid those who are sick and stay home when you are sick. o Cover your mouth and nose when sneezing or coughing. o Wash your hands and avoid touching your eyes, nose, or mouth. • Visit the following sites for more information on: o Cough etiquette (the CDC's *Cover Your Cough*) at https://www.cdc.gov/flu-resources/media/pdfs/2024/08/covercough_hcp11x17.pdf. o Handwashing ▪ *Hand Washing: Reducing the Risk of Common Infections* (Canadian Centre for Occupational Health and Safety) at https://www.ccohs.ca/oshanswers/diseases/washing_hands.html and the ▪ *Handwashing Facts* (CDC) at https://www.cdc.gov/clean-hands/data-research/facts-stats/index.html (CDC). • Encourage vaccination.[7]

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Goal	Suggested Strategies or Resources
Proactively manage patient expectations for an antibiotic.	• One tool shown to decrease unnecessary prescriptions in an outpatient clinic is to have a poster-sized letter signed by all the clinicians and posted in exam rooms stating their commitment to decreasing inappropriate antibiotic use (e.g., for acute respiratory infections).[12] • Many great resources are available **from the CDC** at https://www.cdc.gov/antibiotic-use/communication-resources/index.html. Try some of these: o brochure: *Antibiotics Aren't Always the Answer* (https://www.cdc.gov/antibiotic-use/pdfs/AntibioticsArentAlwaystheAnswer-H.pdf). o chart: *Viruses or Bacteria. What's Got You Sick*? (https://www.cdc.gov/antibiotic-use/pdfs/VirusOrBacteria-Original-P.pdf). o poster: *Can I Feel Better Without Antibiotics*? (https://www.cdc.gov/antibiotic-use/media/pdfs/can-i-feel-better-508.pdf). • Try these slogans on your pharmacy or office materials, newsletters, websites, etc: o "Coughs, colds – take care, not antibiotics." o "Antibiotics – misuse them and you may lose them."
Address patient demand for an antibiotic. *Continued…*	• Tell patients that antibiotics don't help viral infections like colds, the flu, bronchitis, and many ear infections.[7] • Dispel the myth that discolored mucus means patients need antibiotics. Thickened, yellow or green mucus just means that your body is fighting an infection which could be viral or bacterial.[10] • Patient satisfaction is highest, and the number of unneeded antibiotic prescriptions is lowest if patients receive a combination of both positive (e.g., use saline to help with congestion) and negative (e.g., this is a viral infection and antibiotics won't help) treatment recommendations AND a **contingency plan**.[11] • **Contingency plans** can include:[11] o Watch and wait to see if there is improvement in symptoms over a couple of days. o Tell the patient when to return. o Let patients know how to easily follow-up with providers. o Give a post-dated prescription. o Follow-up with patients in two or three days with the potential for a prescription at that time. • Give patients with an acute viral respiratory infection a "prescription" so they don't leave empty-handed. It gives them instructions to help with typical symptoms, lets them know their diagnosis, and tells them that antibiotics won't help. o Use the CDC's **symptom relief for viral illness Rx** at https://www.cdc.gov/antibiotic-use/media/pdfs/rcx-relief-viral-illness-sm-v8-508.pdf. o In Canada, a similar Rx is available from Choosing Wisely (https://choosingwiselycanada.org/primary-care/antibiotics/). There is an Rx for adults, one for pediatrics, and a delayed prescription.

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Goal	Suggested Strategies or Resources
Address patient demand for an antibiotic, continued	• Prescribers can find a dialogue to help them have effective conversations with patients at https://nccid.ca/wp-content/uploads/sites/2/2016/11/PatientDialogue.pdf. This is an evidence-based "script" aimed at reducing unnecessary antibiotic prescriptions and reassuring patients. • When an antibiotic is not indicated, try these **tips and talking points to curtail antibiotic demand**: o Emphasize potential antibiotic-associated harm to the **patient** (e.g., *C. difficile*, yeast infection) or others close to them (e.g., resistant bacteria can spread between people), as opposed to societal harm (e.g., increased healthcare expenditures, widespread antibiotic resistance).[31] Other examples: ▪ Taking an antibiotic may harm your "good bacteria," making it easier for you to get another infection.[31] ▪ Antibiotics are the most common cause of emergency department visits for adverse drug reactions in children.[31] ▪ Resistant bacteria can be found in your gut years after taking an antibiotic.[31] o Refer to bronchitis as a "chest cold" to limit expectations of an antibiotic.[7] o Inform patients that they can expect a cold to last up to 10 days, and a cough can persist for up to two months.[20] • Empower nurses, technicians, etc to educate and increase awareness of antibiotic overuse/inappropriate use. • Let patients know that they've been heard.
Empower patients for self-care.	• Patient guides for symptom-targeted treatment of common infections are available at: o CDC: *Treatment of Common Illnesses*, at https://www.cdc.gov/antibiotic-use/?CDC_AAref_. o Canada (Alberta Health): *Guide to Wise Use of Antibiotics*, at https://dobugsneeddrugs.org/guide-to-wise-use-of-antibiotics/. • Discourage patients from using an antibiotic they find available internationally or online for self-diagnosed infections. o Tell patients not to save any leftover antibiotics and never to use any of these medications. o Instruct patients on how to dispose of their old medications.
Use antibiotic prophylaxis appropriately before dental procedures.	• Know when antibiotics are needed and when they are NOT needed before dental procedures. o For the prevention of **endocarditis**, see the American Heart Association wallet card: https://www.heart.org/-/media/Files/Health-Topics/Infective-Endocarditis/Infective-Endocarditis-Wallet-Card.pdf?sc_lang=en o For information on antibiotic prophylaxis in patients with **hip or knee prostheses**, see the American Academy of Orthopaedic Surgeons/American Association of Hip and Knee Surgeons guideline (endorsed by the IDSA) at https://www.aaos.org/globalassets/quality-and-practice-resources/dental/dental-2024/prevention-of-total-hip-and-knee-arthroplasty-pji-in-patients-undergoing-dental-procedures-cpg.pdf.
Dose antibiotics correctly.	• Verify appropriate antibiotic dosing for patients with poor renal function or who are obese (e.g., for aminoglycosides, beta-lactams, colistin, daptomycin, sulfamethoxazole/trimethoprim, vancomycin). See our FAQ, *Medications and Kidney Function*.

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Goal	Suggested Strategies or Resources
Switch from IV to oral when appropriate.	• Limit IV to PO stepdown therapy to patients who are hemodynamically stable, who can tolerate and absorb oral medications (e.g., has not vomited in the past 24 hours), who have been afebrile for 24 hours, whose white blood cell count and C-reactive protein are normalizing, and who will be adherent.[15,16,30] • Generally avoid switching to oral without specialist consultation if source control has not been achieved (e.g., undrained abscess, empyema), or if the patient has meningitis, a severe or necrotizing soft tissue infection, infections requiring high antibiotic tissue levels or prolonged IV therapy, infection associated with a foreign body, immunocompromise, a deep-seated infection, a critical infection with high mortality, or septic arthritis.[15,16,29] • Certain patients with gram-positive endocarditis could be switched to oral therapy after about two weeks of IV therapy.[2] • Bacteremia with the most evidence for IV to PO switch stems from enterobacterales urinary tract infections and community-acquired pneumonia caused by *Streptococcus pneumoniae*.[29,30] There is emerging evidence to support IV to PO stepdown therapy for gram-positive bacteremia.[30] • *Oral Antibiotics for Acute Osteomyelitis in Adults* may be appropriate. • See our chart, *Considerations for IV-to-PO Conversions* for drug-specific considerations.

Monitor antibiotic therapy and ensure appropriate follow-up.	• Follow up on and modify treatment based on the results of the culture and sensitivities.
	  ○ Choose oral antibiotics based on culture results, source of infection, adverse effects, and bioavailability.[29]
	  • For example, for uncomplicated *Staphylococcus aureus* bacteremia, consider linezolid (high bioavailability) over doxycycline, a beta-lactam (low serum concentrations), or fluoroquinolone/rifampin (adverse effects).[30,32]
	• Where appropriate, consider adding a requirement to antibiotic orders of a stop date and the indication for the antibiotic. In the long-term care setting, the antibiotic start date (in the hospital) would also be helpful.
	• Develop a follow-up program where someone (prescriber, nurse, pharmacist) calls to see if a patient's symptoms have improved, if patients have any questions about symptom relief, etc.

Know best practices for infusing beta-lactams.	• Extended infusions are infused over 3 to 4 hours, continuous infusions are infused over the entire dosing interval, and traditional intermittent infusions are infused over 30 to 60 minutes.[39] • Data supports use of continuous infusions in critically ill patients with severe, drug-resistant gram-negative infections to improve survival or clinical cure.[21,39] But in theory, continuous infusion should benefit all infections.[21] • Antibiotics with the most data as continuous infusions are ceftazidime, piperacillin-tazobactam, and meropenem.[21,39] Penicillin G has been studied mostly in stable patients, such as in home health patients.[41] • Consider potential drawbacks (e.g., need for a dedicated line, antibiotic stability constraints).[21] • Suggest a one-time loading dose before starting a continuous infusion.[39] It is unclear if a loading dose given before an extended infusion is beneficial.[39]

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Goal	Suggested Strategies or Resources
	• Therapeutic drug monitoring can be considered.[39] When therapeutic drug monitoring is done, the suggested target level for continuous infusions is ≥4 times the MIC.[39] For extended infusions, it is suggested that the level remain above the MIC 50% to 70% of the time.[39]
Prevent readmissions.	• Use our *Transitions of Care Checklist*, to keep medication lists up to date. • Ensure appropriate post-discharge follow-up is scheduled and communicated to the patient. • Use our toolbox, *Medication Adherence Strategies*, to help patients stay on their meds.

Abbreviations: ASHP = American Society of Health-System Pharmacists; CDC = Centers for Disease Control and Prevention; IDSA = Infectious Diseases Society of America; PIDS = Pediatric Infectious Diseases Society; SHEA = Society for Healthcare Epidemiology of America; SIS = Surgical Infection Society; WHO = World Health Organization

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