Antimicrobial Stewardship

(Modified October 2023)

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] Up to 50% of all antibiotics are prescribed incorrectly.[18] Antibiotics are essential medications, but their overuse and misuse is contributing to the development of resistant bacteria. Almost three million people in the US become infected with an antibiotic-resistant bacteria leading to more than 35,000 deaths each year.[18] Resistance is increasing faster than new antibiotics can be developed, threatening the ability to treat certain infections.[23] The toolbox below 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.	• The **CDC** has educational resources, continuing education, and training opportunities related to antibiotic stewardship at https://www.cdc.gov/antibiotic-use/training/index.html.
	  ○ Core Elements of Antibiotic Stewardship are available at https://www.cdc.gov/antibiotic-use/core-elements/index.html.
	  ○ Core Elements of Hospital Antibiotic Stewardship Programs is available at https://www.cdc.gov/antibiotic-use/core-elements/hospital.html#anchor_1617121430620. Contains information on pharmacist involvement.
	  ○ Core Elements of Outpatient Antibiotic Stewardship are available at https://www.cdc.gov/antibiotic-use/core-elements/outpatient.html.
	  ○ Core Elements of Antibiotic Stewardship for Nursing Homes is available at https://www.cdc.gov/antibiotic-use/core-elements/nursing-homes.html.
	  ○ Continuing Education and Informational Resources at https://www.cdc.gov/antibiotic-use/training/continuing-education.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fantibiotic-use%2Fcommunity%2Ffor-hcp%2Fcontinuing-education.html.
	• 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** Physician Alliance has implementation guides and tools at https://www.ahaphysicianforum.org/resources/appropriate-use/antimicrobial/index.shtml.
	• See a compilation of resources from the **Association for Professionals in Infection Control and Epidemiology** at https://apic.org/professional-practice/practice-resources/antimicrobial-stewardship/.

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Take steps to develop and improve your antimicrobial stewardship program.	• **Choose your program's multidisciplinary team** (optimally an infectious disease pharmacist, infectious disease physician, clinical microbiologist, information system specialist, hospital epidemiologist, infection control professional), and consider formal antimicrobial stewardship for pharmacist and/or physician program leaders.[23,36-38] Ideally, the physician and pharmacist will be co-leaders of the program.[18] • **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 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 results will be reported** to prescribers, pharmacists, nurses, and administrators.[18] • **Ensure you have all the core elements** (see **https://www.cdc.gov/antibiotic-use/core-elements/hospital.html**).
Educate yourself and your colleagues with available resources. *Continued…*	• 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/week/toolkit.html. • Visit **Antibiotic Awareness Week Canada** at https://antibioticawareness.ca/ for patient and provider information, videos, factsheets, and treatment guidelines. • A training module for talking with patients about antibiotics during a primary care office visit is available at https://www.conversationsforhealth.com/antibiotics/. • 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.

Goal	Suggested Strategies or Resources
Educate yourself and your colleagues with available resources, continued	○ Sinusitis (American Academy of Family Physicians): https://www.aafp.org/family-physician/patient-care/clinical-recommendations/all-clinical-recommendations/cw-sinusitis.html. ○ 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. • 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: ○ For adults: https://www.cdc.gov/antibiotic-use/clinicians/adult-treatment-rec.html. ○ For pediatrics: https://www.cdc.gov/antibiotic-use/clinicians/pediatric-treatment-rec.html.
Access resources related to accreditation (US).	• **Joint Commission**, New and Revised Antibiotic Stewardship Requirements: ○ https://www.jointcommission.org/-/media/tjc/documents/standards/prepublications/effective-2023/compare_hap_jan2023_prepublication_report_antibiotic_stewardship.pdf. ○ https://www.jointcommission.org/-/media/tjc/documents/standards/r3-reports/r3_antibioticstewardship_july2022_final.pdf. • **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. Data are shared on antibiotic use and resistance patterns to help you identify areas for improvement.[22]

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] **Candidiasis** • FAQ, *Managing Candidiasis.* ***Clostridioides difficile*** • See below. **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/36/44/3075/2293384?login=false. **MRSA** • FAQ, *Vancomycin Dosing and Monitoring in Adults*. • Chart, *Antibiotics for MRSA Skin Infections.* **Osteomyelitis** • Chart, *Oral Antibiotics for Acute Osteomyelitis in Adults*. **Respiratory Infections** • See below. **Sepsis** • Chart, *Sepsis Management in Adults: Pharmacotherapy Focus.* **Skin and Soft Tissue Infections** • See our chart, *Antibiotics for MRSA Skin Infections*. • 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** • See below.

Goal	Suggested Strategies or Resources
Use antibiotics appropriately for respiratory infections.	• COPD exacerbation: see our toolbox, *Improving COPD Care.* • Otitis externa: treat uncomplicated otitis externa (swimmer's ear) with topical antibiotics rather than oral antibiotics to minimize resistance.[25] • Otitis media, acute: use watchful waiting for certain children with acute otitis media to limit antibiotic use. o See our FAQ, *Acute Otitis Media*, for more information about when to use antibiotics to treat acute otitis media. • Pharyngitis: most sore throats are caused by viruses and do not need antibiotics.[24] Penicillin or amoxicillin are the antibiotics of choice for strep throat.[24] • Pneumonia (community-acquired): see our chart, *Treatment of Community-Acquired Pneumonia in Adults.* • Pneumonia (hospital-acquired or ventilator-associated), see our FAQ, *Hospital-Acquired and Ventilator-Associated Pneumonia.* • Sinusitis: most cases of sinusitis are caused by viruses. Consider two to three days of watchful waiting before prescribing an antibiotic.[27]
Address asymptomatic bacteriuria and urinary tract infections.	• Avoid urine cultures in most patients that don't have urinary symptoms. • Treat uncomplicated urinary tract infections appropriately: o Choose nitrofurantoin or trimethoprim/sulfamethoxazole (depending on local resistance patterns) for most patients.[19] o Avoid quinolones due to the development of resistance and adverse effects.[19,28] o See our FAQ, *Urinary Tract Infections in Adults.* • See our FAQ, *Prostatitis*, for appropriate antibiotics to treat prostatitis.
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 resources including FAQs, prevention strategies, patient education sheets, links to guidelines, expert commentaries, and more at https://www.cdc.gov/cdiff/clinicians/index.html. o Find more information in the IDSA/Society for Healthcare Epidemiology of America (SHEA) 2021guidelines on management of C. difficile in adults at https://academic.oup.com/cid/article/73/5/e1029/6298219.
Prevent and treat other gastrointestinal conditions	• Use our FAQ, *Acute Infectious Diarrhea*, to review appropriate antibiotic use for acute infectious diarrhea. • Antibiotics may not be appropriate for all cases of acute pancreatitis. See our FAQ, *Pancreatit*s, for details. • Use our *Natural Medicines* database to identify probiotics with evidence to prevent some gastrointestinal conditions.

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Appropriately treat acne to limit resistance.	• Limit duration of oral antibiotics for **acne** (e.g., can usually stop in about 12 weeks). Suggest combining oral or topical antibiotics with topical benzoyl peroxide or a retinoid to help avoid resistance in 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 the World Health Organization'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/global-guidelines-for-the-prevention-of-surgical-site-infection-2nd-ed. • See the CDC's Checklist for Prevention of Central Line Associated Blood Stream Infections at https://www.cdc.gov/hai/pdfs/bsi/checklist-for-CLABSI.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] • If tests are done to identify causative organisms, wait for results before prescribing antibiotics if safe to do so. • Procalcitonin testing, in conjunction with clinical judgment, can help support the decision to discontinue antibiotic therapy in hospital- or ventilator-associated penumonia.[17] • Consider offering point-of-care tests in the pharmacy to evaluate whether antibiotics are necessary (e.g., influenza, strep, COVID-19).
Be aware of special considerations in pediatric patients. *Continued…*	• 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 up-to-date to prevent weight-based doses in bigger kids from exceeding maximum recommended antibiotic doses.[26] For example, if a 50 kg child is prescribed ceftriaxone 50 mg/kg for pneumonia, which equals 2,500 mg, which exceeds 2 g/dose maximum. o Find antibiotic **dosing** guidance from: • The American Thoracic Society (lung infections in patients with cystic fibrosis) at https://www.atsjournals.org/doi/full/10.1513/AnnalsATS.201402-050AS. • Cystic Fibrosis Canada at https://www.cysticfibrosis.ca/uploads/Antibiotic%20Dosing%20Guideline%20Aug%202021.pdf. • European Society for Paediatric Infectious Diseases (bone and joint infections) at https://journals.lww.com/pidj/Documents/Aug%202017%20ESPID%20Bone_and_Joint_Infections.pdf. • Canadian Paediatric Society (bone and joint infections) at https://cps.ca/en/documents/position/osteoarticular-infections-in-children.

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Pediatric considerations, continued	• 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 (https://www.cps.ca/en/documents/position/antimicrobial-stewardship), for additional outpatient resources.
Limit adverse drug reactions associated with antibiotics.	• Remind patients who insist on unnecessary antibiotics about their downsides: adverse effects, drug interactions, and costs. For example, central nervous system effects or arthropathy with quinolones, antibiotic-associated or *Clostridioides difficile* diarrhea, promotion of resistant bacteria, and allergic reactions.[1] • 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 penicillin allergy necessitates a broader spectrum antibiotic. Resources include: o Our FAQ, *Managing Beta-Lactam Allergies*, for help. o The CDC resource, Evaluation and Diagnosis of Penicillin Allergy for Healthcare Professionals at https://www.cdc.gov/antibiotic-use/clinicians/penicillin-allergy.html. • 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: o US National Action Plan for Combating Antibiotic-Resistant Bacteria at https://aspe.hhs.gov/sites/default/files/migrated_legacy_files//196436/CARB-National-Action-Plan-2020-2025.pdf. o Canada's Antimicrobial Resistance and Use in Canada: A Federal Framework for Action at https://www.canada.ca/en/public-health/services/antibiotic-antimicrobial-resistance/antimicrobial-resistance-use-canada-federal-framework-action.html. o CDC's Antibiotic Resistance Solutions Initiative at https://www.cdc.gov/drugresistance/solutions-initiative/index.html. • The US National Action Plan specifically mentions these worrisome trends:[5] o the discovery of new resistant pathogens (e.g., *Candida auris*). o an increase in community-acquired drug-resistant group A Strep infection. o community-acquired infections with extended-spectrum beta-lactamase-producing Enterobacterales. o an increase in resistant *Neisseria gonorrhoeae* infections. • Minimize use of broad-spectrum antibiotics and/or refer to your local antibiogram if available. • Use CDC's *Healthcare Facilities: Information about CRE* (https://www.cdc.gov/hai/organisms/cre/cre-facilities.html) for information on transferring patients with CRE, containment strategies, and hand hygiene guidance. • See our FAQ, *Resistant Gram-Negative Bacterial Infections*.

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Identify infections at risk of antibiotic overuse.	• Outpatient antibiotics make up about 80% to 90% of prescribed antibiotics and at least 28% are unnecessary.[21] Over 50% of antibiotic prescribing in hospitals is inconsistent with recommended prescribing practices.[18] • Maintain a high index of suspicion for common viral infections that do not benefit from antibiotics (e.g., influenza, coronaviruses [e.g., COVID-19]).[8] • Recognize common infections that are usually viral and/or only need antibiotics in limited circumstances:[8] o bronchitis, most coughs and sore throats, some ear infections, gastroenteritis, and some sinus infections.
Use vaccines to prevent infection.	**Influenza** • Get vaccinated to set a good example for patients and coworkers. • Vaccinate all patients six months and older against influenza, including pregnant women, yearly.[15,16] • US subscribers can stay up-to-date on the latest regarding prevention, treatment, diagnosis, and flu activity on social media. o Facebook: https://www.facebook.com/CDC o Twitter: https://twitter.com/CDCFlu • Use our chart, *Flu Vaccines,* to choose the best vaccine for patients. • Canadians can get information and materials to educate healthcare professionals about flu vaccination and other preventive actions from the Government of Canada at https://www.canada.ca/en/public-health/services/diseases/flu-influenza/health-professionals.html. **Pneumonia** • See our chart, *Comparison of Pneumococcal Vaccines*. **COVID-19** • Use our chart, *COVID-19 Vaccines*, to choose the most appropriate vaccine for patients. • Use our FAQ, *Communication About COVID-19 Vaccination*, to answer common questions about COVID-19 vaccination and address misconceptions. **Other immunization** schedules are available at: o US: https://www.cdc.gov/vaccines/schedules/index.html. o Canada: https://www.canada.ca/en/public-health/services/provincial-territorial-immunization-information.html. o See our FAQ, *Vaccinating Immunocompromised Patients*.

Goal	Suggested Strategies or Resources
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 at https://www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm. o Handwashing at https://www.ccohs.ca/oshanswers/diseases/washing_hands.html. • Handwashing fact sheets for patients for distribution or display are available at https://www.cdc.gov/handwashing/fact-sheets.html. • Screen patients to identify those in need of immunizations. See resources, above. • Set the stage for patients before they get an acute respiratory infection. Try to preempt a patient request for an unneeded antibiotic by discussing these issues before they are sick (e.g., at well visits). • Educate patients with: o posters in your pharmacy, office, clinic, etc. o patient handouts with references to websites, video links. o post information on your websites and social media sites that your pharmacy or office uses. o inclusion of information in an electronic newsletter or appointment reminders sent out to patients.
Manage patient expectations *Continued…*	• Tell patients that antibiotics don't help viral infections like colds, the flu, bronchitis, and many ear infections.[7] • Prescribers want to be consistent with their public commitment to reduce antibiotic overuse.[12] 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] • Know the reasons for over diagnosis of bacterial acute respiratory infections: o diagnostic uncertainty. Set up a contingency plan (see below) to counter this. o perceived patient expectation for an antibiotic. • 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 nose spray 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.

Goal	Suggested Strategies or Resources
Manage Patient Expectations, continued	• 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/community/pdfs/aaw/CDC-AU_RCx_Relief_for_Viral_Illness_sm_v8_508.pdf. o In Canada, a similar Rx is available at https://centreinfection.typeform.com/to/HpHCYi?typeform-source=antibioticawareness.ca. There is an Rx for adults and one for pediatrics. • 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 communication aimed at reducing unnecessary antibiotic prescriptions and reassuring patients. • Keep in mind, prescribers may be evaluated on a quality measure of how often you DON'T give antibiotics to kids with upper respiratory infections. • When a viral infection is diagnosed, try these **tips and talking points to curtail antibiotic demand**: o Taking antibiotics for viral infections affects the 'good' bacteria in your body that are not causing disease and could lead to resistance. o Some bacteria are only susceptible to a limited number of antibiotics. Overusing these antibiotics can lead to resistance, which may reduce your options for treatment, particularly when you need to take into account any allergies or previous adverse effects. o Refer to bronchitis as a "chest cold" to limit expectations of an antibiotic. 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] o Empower nurses, technicians, etc to educate and increase awareness of antibiotic overuse/inappropriate use. o Let patients know that they've been heard. o Explain risks and harm of unnecessary antibiotics (adverse drug reactions, increased resistance, drug interactions, etc). • Many great resources are available **from the CDC** at https://www.cdc.gov/antibiotic-use/community/materials-references/print-materials/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/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." • 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.

Goal	Suggested Strategies or Resources
Empower patients for self-care.	• Most acute respiratory infections are viral and self-limiting. Community pharmacies are often the first-line of advice. • 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/common-illnesses.html. o Canada (Alberta Health): *Guide to Wise Use of Antibiotics*, at https://dobugsneeddrugs.org/guide-to-wise-use-of-antibiotics/. • Refer severely ill patients, those with co-morbidities that complicate infections, those with prolonged infections, or if you're uncomfortable judging if it's viral.
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 Association of Endodontists quick reference guide at https://www.aae.org/specialty/wp-content/uploads/sites/2/2017/06/aae_antibiotic-prophylaxis-2017update.pdf. • American Heart Association's Scientific Statement, Prevention of Viridans Group Streptococcal Infective Endocarditis at https://www.ahajournals.org/doi/pdf/10.1161/CIR.0000000000000969. o For information on antibiotic prophylaxis in patients with orthopedic implants, see the American Academy of Orthopaedic Surgeon/American Dental Association criteria for appropriate use at https://www.aaos.org/globalassets/quality-and-practice-resources/dental/pudp_guideline.pdf.
Monitor antibiotic therapy and ensure appropriate follow-up. *Continued…*	• Work with your hospital to implement policies for restricting broad spectrum antibiotics to certain prescribers or indications. Use our FAQ, *Resistant Gram-Negative Bacterial Infections* for more on these antibiotics. • Follow up on and modify treatment based on the results of the culture and sensitivities. • Ensure appropriate antibiotic durations of therapy. See our FAQ, *Antibiotic Therapy When Are Shorter Courses Better?* • 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*. • Follow protocols to convert patients from intravenous (IV) to oral (PO) antibiotic therapy as soon as clinically appropriate. o Limit IV to PO stepdown therapy to patients who are hemodynamically stable, who can tolerate and absorb oral medications, and who will be adherent.[29,30] o Avoid switching to oral agent if source control has not been achieved.[29] o **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] There is only limited evidence to support IV to PO stepdown therapy for gram-positive bacteremia.[30,34] Generally limit oral step-down to uncomplicated cases (e.g., no metastatic infection, no prosthetic material, no endocarditis, negative follow-up blood cultures two to four days after the first positive culture, defervescence within 72 hours of starting treatment).[30-32,34] o Certain patients with gram positive endocarditis could be switched to oral therapy after about two weeks of IV therapy.[2]

Goal	Suggested Strategies or Resources
Monitor antibiotic therapy and ensure appropriate follow-up, continued	○ 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. • 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 days with IV; switching to oral is not needed.[33]
Know best practices for infusing beta-lactams.	• Promote use of extended (e.g., three to four hours) or continuous beta-lactam infusion over intermittent infusion (e.g., 30 to 60 minutes) for patients most likely to benefit.[41,43] ○ Generally, these are patients with poorly susceptible gram negative infections and physiologic processes that increase volume of distribution (e.g., sepsis) or enhance beta-lactam elimination (e.g., augmented renal clearance in critically ill patients).[39,41] ○ Compared to intermittent infusion, extended or continuous infusion may improve clinical cure or survival in severely ill patients.[43] ○ Beta-lactams with the most data for use by extended or continuous infusion are ampicillin/sulbactam, cefazolin, cefepime, ceftazidime, meropenem, and piperacillin/tazobactam.[42] • Assign appropriate expiration times for extended and continuous infusions. This will depend on concentration, diluent, infusion device, and environmental temperature.[42] • Suggest a one-time loading dose before starting a continuous infusion.[43] It is unclear if a loading dose given before an extended infusion is beneficial.[43] • If available, suggest checking beta-lactam levels in critically ill patients (especially those with sepsis, burns, obesity, severe kidney impairment) to maximize time above the minimum inhibitory concentration (MIC).[39,40] Preliminary data suggests meeting target indices reduces mortality.[41] Sampling can occur at any time at steady-state during continuous infusions, but a trough level is recommended for extended infusions, 24 to 48 hours after initiation.[40] The suggested target level for continuous infusions is ≥4 times the MIC.[43] For extended infusions, it is suggested that the level remain above the MIC 50% to 70% of the time.[43] • Recognize limitations to continuous or extended infusions (e.g., need for a dedicated IV line, increased pharmacist and nursing workload, limited patient mobility, IV site infection, risk of infusion errors).[23,44,46] • Educate nursing staff on proper administration of extended or continuous infusions. Points to cover might include rationale for prolonged infusions; drug incompatibilities; infusion stability and use of cold packs to prolong stability (e.g., with certain carbapenems); the difference between duration of infusion and dosing interval (for extended infusions); tubing residuals; and checking levels to optimize dosing.[42,44,45]

Goal	Suggested Strategies or Resources
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: CDC = Centers for Disease Control and Prevention; IDSA = Infectious Diseases Society of America.

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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