Florida Department of Health

Health Care-Associated Infection Prevention Program

Antimicrobial Stewardship Toolkit

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Florida Department of Health

Health Care-Associated Infection Prevention Program

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Introduction

The purpose of this Antimicrobial Stewardship Program (ASP) Toolkit is to provide helpful resources for improving the use of antimicrobials in patients cared for in all health care settings (e.g., inpatient and outpatient, including emergency/urgent care settings). The toolkit is intended for all clinicians interested in improving the use of antimicrobials in all settings. This includes frontline clinicians, antimicrobial stewardship teams, and other groups interested in improving antimicrobial use.

Antimicrobials have been used since the 1940s to treat infectious diseases and to perform surgery and chemotherapy. Despite the many lifesaving benefits of these drugs, antimicrobials have negative side effects including increased risk of hospitalization, cost of treatments, risk of death, and risk of adverse events such as *Clostridioides difficile* (*C. difficile*) infection. Additionally, antimicrobials cause selective pressure leading to increases in antimicrobial-resistant organisms. Antimicrobial resistance occurs when germs like bacteria and fungi develop the ability to defeat the drugs designed to kill them. These changes happen naturally over time but are accelerated when antimicrobials are used inappropriately. Infections caused by drug-resistant organisms are difficult to treat and often require extended hospital stays, treatment with more toxic drugs, and increased medical costs.

Antimicrobial resistance is one of the biggest public health challenges affecting health care, veterinary and agricultural industries around the world. The increased spread of antimicrobial-resistant organisms has been fueled by modern globalization, increasing the ease by which people, animals, and goods move around the globe. The Centers for Disease Control and Prevention (CDC) estimates that antimicrobial-resistant organisms cause more than 2.8 million infections and more than 35,000 deaths per year in the U.S.

Antimicrobial Stewardship

Antimicrobial stewardship is a set of coordinated interventions designed to improve and measure the appropriate use of antimicrobials by promoting the selection of the optimal antimicrobial drug regimen, dose, duration, and route of administration. Antimicrobial stewardship has four main goals:

- Achieve optimal clinical outcomes
- Minimize toxicity and adverse events
- Reduce costs of health care
- Limit selection for resistant strains

The CDC Assessment Tool

This checklist will assist hospitals in assessing key elements needed for creating a program that ensures optimal antimicrobial prescribing and appropriate use. The key elements of a successful ASP include leadership commitment, accountability, pharmacy expertise, action, tracking, reporting and education.

Core Elements of Hospital Antimicrobial Stewardship Programs

Hospital Antimicrobial Stewardship Programs

Optimizing the use of antimicrobials is critical to effectively treat infections, protect patients from harm caused by unnecessary antimicrobial use, and combat antimicrobial resistance. Antimicrobial stewardship programs (ASPs) can help clinicians improve clinical outcomes and minimize harm by improving antimicrobial prescribing. Hospital antimicrobial stewardship programs can increase infection cure rates while reducing:

- Treatment failures
- *C. difficile* infections
- Adverse effects
- Antimicrobial resistance
- Hospital costs and lengths of stay

A goal for any antimicrobial stewardship program is to meet all seven of the CDC core elements of an ASP. The following steps should help you achieve that goal. The toolkit has a section for each core element.

Build the Case for Antimicrobial Stewardship

- The Joint Commission requirements
- The National Action Plan for Combating Antibiotic-Resistant Bacteria call for all acute-care hospitals to have an ASP
- Adverse drug reactions and other complications of antimicrobial use, including *C. difficile* infection, are increasing
- Economic impact of antibiotic resistance
- Center for Medicare & Medicaid Services Condition of Participation

Core Elements of Hospital Antimicrobial Stewardship Programs

1. Hospital Leadership Commitment

Dedicate necessary human, financial, and information technology resources. A lack of necessary resources is commonly cited as the top barrier to success by stewardship programs.

Examples of leadership commitment include:

- Giving stewardship program leader(s) time to manage the program and conduct daily stewardship interventions.
- Providing resources, including staffing, to operate the program effectively.
- Having regular meetings with leaders of the stewardship to assess the resources needed to accomplish the hospital's goals for improving antimicrobial use.
- Appointing a senior executive leader to serve as a point of contact or "champion" for the stewardship program to help ensure that the program has resources and support to accomplish its mission.

- Reporting stewardship activities and outcomes (including key success stories) to senior leadership and the hospital board on a regular basis.
- Integrating antimicrobial stewardship activities into other quality improvement and patient safety efforts, such as sepsis management and diagnostic stewardship.
- Having clear expectations for the leaders of the program on responsibilities and outcomes.
- Making formal statements of support for efforts to improve and monitor antimicrobial use.
- Outlining stewardship-related duties in job descriptions and annual performance reviews for program leads and key support staff.
- Supporting training and education for program leaders and hospital staff.
- Supporting enrollment in and reporting to the National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance (AUR) Module.
- Supporting participation in local, state and national antimicrobial stewardship quality improvement collaboratives.
- Ensuring that staff from key support departments have enough time to contribute to stewardship activities.

Obtain Leadership Commitment Letter

- Example from Minnesota Hospital Association

Develop a Business Plan

- Example from Society for Healthcare Epidemiology of America (SHEA)

Develop an ASP Policy

- Example from Cardinal Health

ASP Team and Committee Members

Core Personnel:

- Infectious Diseases Physician
- ID Pharmacist preferably with training in antimicrobial stewardship
- Data Analyst

Other Essential Personnel:

- Infection Preventionist
- Microbiologist
- Nursing Leader
- Physicians from services impacted by the ASP
- Clinical Pharmacists
- Family Advisor/Advocate
- Quality Improvement Specialists

Resources

- CDC. Antimicrobial Management Program Gap Analysis Checklist. Atlanta, GA: CDC; 2010. www.ahaphysicianforum.org/resources/appropriate-use/antimicrobial/content%20files%20pdf/CDC%20checklist.pdf.
- Kravitz GR. Making the Business Case for ASP: Taking It to the C-Suit [PowerPoint]. St. Paul, MN: St. Paul Infectious Disease Associates; 2015. www.shea-online.org/images/priority-topics/Business_Case_for_ASP.pdf.
- Spellberg B, Srinivasan A, Chambers HF. New societal approaches to empowering antibiotic stewardship. *JAMA*. 2016;315(12):1229-1230. www.jamanetwork.com/journals/jama/article-abstract/2498636.
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- CDC. Antibiotic Resistance Threats in the United States, 2013. Atlanta, GA: CDC; 2013. www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf.
- CDC. Antibiotic Use in the United States: Progress and Opportunities. Atlanta, GA: CDC; 2017. www.cdc.gov/antibiotic-use/stewardship-report/pdf/stewardship-report.pdf.
- CDC. Antibiotic Use in the United States: Progress and Opportunities, 2018 Update. Atlanta, GA: CDC; 2019. www.cdc.gov/antibiotic-use/stewardship-report/pdf/stewardship-report-2018-508.pdf.
- CDC. Stewardship Program Examples. www.cdc.gov/antibiotic-use/healthcare/programs.html.
- CDC. The Core Elements of Hospital Antibiotic Stewardship Programs. Atlanta, GA: CDC; 2014. www.cdc.gov/antibiotic-use/healthcare/pdfs/core-elements.pdf.
- AHA Physician Alliance. Antimicrobial Stewardship Toolkit. www.ahaphysicianforum.org/resources/appropriate-use/antimicrobial/.
- EQuIP Program. Jump Start Stewardship: Implementing Antimicrobial Stewardship in a Small, Rural Hospital. Seattle, VA: EQuIP; 2016. www.doh.wa.gov/Portals/1/Documents/5600/JumpstartStewardshipWorkbook.pdf
- Institute for Healthcare Improvement. Antibiotic Stewardship Driver Diagram and Change Package. 2012. www.cdc.gov/antibiotic-use/healthcare/pdfs/Antibiotic_Stewardship_Change_Package.pdf.
- National Quality Partners Playbook: Antibiotic Stewardship in Acute Care. Washington, DC: NQF; 2016. www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=82501.
- Minnesota Department of Health. Acute Care Antibiotic Stewardship Program Resource List. www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ac/aspresources.pdf.
- California Department of Health. Antimicrobial Stewardship Program Toolkit. 2015. www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/ASPToolkit2015FINAL_ADA.pdf.

2. Accountability

The ASP must have a designated leader or co-leaders who are accountable for program management and outcomes. Most hospitals have found a co-leadership model to be effective; according to the 2019 NHSN hospital survey, 59 percent of hospitals in the U.S. have stewardship programs that are co-led by a physician and pharmacist.

Examples of accountability commitment include:

- Regular stewardship rounds for the co-leaders or the non-physician lead and the supporting physician can strengthen program leadership.
- Expanding these rounds to include discussions with prescribers has been shown to improve antimicrobial use and is an effective way to enhance the visibility and support of the stewardship program.
- Training in infectious diseases or antimicrobial stewardship benefits stewardship program leaders.
- Larger facilities have achieved success by hiring full-time staff to develop and manage stewardship programs while smaller facilities report other arrangements, including use of part-time or even off-site expertise, sometimes referred to as telewardship.
- Hospitalists have also proven to be effective physician leaders or supporters for efforts to improve antimicrobial use, especially in smaller hospitals, given their increasing presence in inpatient care, the frequency with which they use antimicrobials and their experience with leading hospital quality improvement projects.

Additional Training Opportunities for Physicians

- Making a Difference in Infectious Diseases (MAD-ID)
- Best Practices for Antibiotic Stewardship Programs at IDweek
- The Society of Healthcare Epidemiology Antibiotic Stewardship Website
- Primer on Healthcare Epidemiology, Infection Control & Antibiotic Stewardship
- Relevant readings or webinars
    - Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America
    - Guidance for the Knowledge and Skills Required for Antibiotic Stewardship Leaders
    - Core Elements of Hospital Antibiotic Stewardship Programs
    - Antibiotic Time Out Training

Job Description of Physician Role

- St. Louis Hospital Example

Resources

- Ostrowsky B, Banerjee R, Bonomo RA, et al. Infectious diseases physicians: Leading the way in antimicrobial stewardship. *Clin Inf Dis*. 2018;66(7):995-1003. www.academic.oup.com/cid/article/66/7/995/4851152.
- Day SR, Smith D, Harris K, et al. An infectious diseases physician-led antimicrobial stewardship program at a small community hospital associated with improved susceptibility patterns and cost-savings after the first year. *Open Forum Infect Dis.* 2015;2(2). www.ncbi.nlm.nih.gov/pmc/articles/PMC4473105/.
- Cosgrove SE, Hermsen ED, Rybak MJ, et al. Guidance for the knowledge and skills required for antimicrobial stewardship leaders. *Infect Control Hosp Epidemiol.* 2014;35(12):1444-1451. www.doi.org/10.1086/678592.
- Mack MR, Rohde JM, Jacobsen D, et al. Engaging hospitalists in antimicrobial stewardship: Lessons from a multihospital collaborative. *J Hosp Med*. 2016;11(8):576-580. www.onlinelibrary.wiley.com/doi/abs/10.1002/jhm.2599.

3. Pharmacy Expertise (previously Drug Expertise)

Highly effective hospital ASPs have strong engagement of a pharmacist, either as a leader or co-leader of the program.

- It is important to identify a pharmacist who is empowered to lead implementation efforts to improve antimicrobial use.
- Infectious disease-trained pharmacists are highly effective in improving antimicrobial use and often help lead programs in larger hospitals and health care systems.
- In hospitals without infectious disease-trained pharmacists, general clinical pharmacists are often co-leaders or pharmacy leaders.
- General clinical pharmacists are more effective when they have specific training or experience in antimicrobial stewardship.

There are a variety of resources to support the antimicrobial stewardship efforts of clinical pharmacists, ranging from posters highlighting key stewardship interventions for pharmacists to formal training and certificate program in stewardship for pharmacists.

Patient and Health Care Provider Information Handouts: www.cdc.gov/antibiotic-use/community/materials-references/print-materials/index.html#anchor_156079019818

Pharmacy Training Programs

- Society of Infectious Diseases Pharmacist Certificate
- MAD-ID certificate

Additional Training Opportunities for Pharmacists

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    - Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America
    - Guidance for the Knowledge and Skills Required for Antibiotic Stewardship Leaders
    - Core Elements of Hospital Antibiotic Stewardship Programs
    - Antibiotic Time Out Training

Job Description Pharmacist Role

- St. Louis Hospital Example

Literature Supporting ASP Pharmacist

- Gross R, Morgan AS, Kinky DE, Weiner M, Gibson GA, Fishman NO. Impact of a hospital-based antimicrobial management program on clinical and economic outcomes. *Clin Infect Dis.* 2001 Aug 1;33(3):289-95.

Resources

- Fortin R. Role of the pharmacist in antimicrobial stewardship. *Rhode Island Medical Journal*. 2018;101(5):26-27. www.rimed.org/rimedicaljournal/2018/06/2018-06-26-antimicrobial-fortin.pdf.
- Waters CD. Pharmacist-driven antimicrobial stewardship program in an institution without infectious diseases physician support. *Am J Health Syst Pharm.* 2015;72(6):466-468. www.ncbi.nlm.nih.gov/pubmed/25736941.
- The Translator. The Pharmacist's Role in Antimicrobial Resistance. *Canadian Pharmacists Association*. 2015;9(3). www.pharmacists.ca/cphaca/assets/File/education-practice-resources/Translator%20Fall_V9_Issue3_2015.pdf.
- The American Society of Health-System Pharmacists. Statement on the Pharmacist's Role in Antimicrobial Stewardship and Infection Prevention and Control. *Medication Therapy and Patient Care: Specific Practice Areas—Statements.* 2010. www.ashp.org/-/media/assets/policy-guidelines/docs/statements/pharmacists-role-antimicrobial-stewardship.ashx?la=en&hash=9B62450AC29F545BB1FEF7301A89E7F0A703AC12.

4. Action

An initial assessment of antimicrobial prescribing can help identify potential targets for interventions.

Interventions to Improve Antimicrobial Use:

Stewardship programs should choose interventions that will best address gaps in antimicrobial prescribing and consider prioritizing prospective audit and feedback, preauthorization and facility-specific treatment guidelines.

- **Prospective audit and feedback** provide an external review of antimicrobial therapy by an expert in antimicrobial use, accompanied by suggestions to optimize use, at some point after the agent has been prescribed. Prospective audit and feedback are different from an antimicrobial "timeout" because the stewardship program, rather than the treating team, conducts the audits.
    - Audit and feedback can be implemented in a variety of ways, depending on the level of expertise available.
    - Stewardship programs with limited infectious diseases expertise might choose to focus reviews on comparing prescribed treatment courses to recommendations in hospital-specific treatment guidelines and focus on common conditions, such as community-acquired pneumonia, urinary tract infection, or skin and soft tissue infections.
    - Programs with more advanced infectious diseases expertise might elect to review more complex antimicrobial treatment courses.
- **Preauthorization** requires prescribers to gain approval prior to the use of certain antimicrobials. This can help optimize initial empiric therapy because it allows for expert input on antimicrobial selection and dosing, which can be lifesaving in serious infections, like sepsis.
    - Decisions on which antimicrobials to place under preauthorization should be made in consultation with providers to focus on opportunities to improve empiric use, rather than on drug costs.
    - Hospitals can tailor the agents, situations, and mechanisms (e.g. preauthorization through an electronic order entry system) to implement preauthorization based on program goals, available expertise, and resources in a way that does not delay therapy for serious infections.
- **Facility-specific treatment guidelines** are also considered a priority because they can greatly enhance the effectiveness of both prospective audit and feedback and preauthorization by establishing clear recommendations for optimal antimicrobial use at the hospital.
    - Recommendations may be based on national guidelines but should reflect hospitals treatment preference based on local susceptibilities, formulary options, and patient mix.

- Ideally, the recommendations should also address diagnostic approaches, such as when to send diagnostic samples and what tests to perform, including indications for rapid diagnostics and non-microbiologic tests (e.g. imaging, procalcitonin). The development of treatment guidelines is a good way for the stewardship program to engage prescriber stakeholders to develop consensus on antimicrobial use.

Common Infection-Based Interventions

More than half of all antimicrobials given to treat active infections in hospitals are prescribed for three types of infections where there are important opportunities to improve use: lower respiratory tract infection (e.g. community acquired pneumonia), urinary tract infection and skin and soft tissue infection. Optimizing the duration of therapy can be especially important because many studies show infections are often treated for longer than guidelines recommend, and data demonstrate that each additional day of antimicrobials increases the risk of patient harm.

- **Community-acquired pneumonia**
    - Interventions have focused on:
        - Improving diagnostic accuracy
        - Tailoring of therapy to culture results
        - Optimizing the duration of treatment to ensure compliance with guidelines
- **Urinary tract infection (UTI)**
    - Many patients who are prescribed antimicrobials for UTIs have asymptomatic bacteriuria that generally does not need to be treated.
    - Successful stewardship interventions focus on:
        - Avoiding obtaining unnecessary urine cultures
        - Avoiding treatment of patients who are asymptomatic, unless there are specific reasons to treat.
    - For patients who need treatment, interventions can focus on ensuring patients receive appropriate therapy based on local susceptibilities for the recommended duration.
- **Skin and soft tissue infection**
    - Interventions have focused on:
        - Ensuring patients with uncomplicated infections do not receive antimicrobials with overly broad spectra (e.g. unnecessary coverage for methicillin-resistant Staphylococcus aureus (MRSA) and gram-negative pathogens)
        - Prescribing the correct route, dosage and duration of treatment.

Provider-Based Interventions

Antimicrobial timeouts: An antimicrobial timeout is a provider-led reassessment of the continuing need and choice of antimicrobials when the clinical picture is clearer and more diagnostic information becomes available, especially results of cultures and rapid diagnostics.

- Antimicrobial timeouts are different from prospective audit and feedback because the providers, not the stewardship team, are doing the reviews.

Assessing penicillin allergy: About 15 percent of hospitalized patients report an allergy to penicillin. However, less than 1 percent of the U.S. population has a serious penicillin allergy that would preclude treatment with a beta-lactam antimicrobial. There are several effective approaches to properly assess penicillin allergies, including history and physical examination, challenge doses, and skin testing.

Pharmacy-Based Interventions

The following interventions are often initiated by pharmacists or embedded into pharmacy sections of electronic health records:

- **Documentation of indications for antimicrobials:** Requiring an indication for antimicrobial prescriptions can facilitate other interventions, like prospective audit and feedback and optimizing post-discharge durations of therapy, and it alone can improve antimicrobial use.
- **Automatic changes from intravenous to oral antimicrobial therapy:** This change can improve patient safety by reducing the need for intravenous access in appropriate situations and for antimicrobials with good absorption.
- **Dose adjustments:** When needed, such as in cases of organ dysfunction, especially renal, or based on therapeutic drug monitoring.
- **Dose optimization:** For example, extended-infusion administration of beta-lactams, particularly for patients who are critically ill and patients infected with drug-resistant pathogens.
- **Duplicative therapy alerts:** Alerts in situations where therapy might be unnecessarily duplicative including simultaneous use of multiple agents with overlapping spectra (e.g. anaerobic activity and resistant gram-positive activity)
- **Time-sensitive automatic stop orders:** For specified antimicrobial prescriptions, especially antimicrobials administered for surgical prophylaxis.
- **Detection and prevention of antimicrobial-related drug-drug interactions:** For example, interactions between some orally administered fluoroquinolones and certain vitamins.

Microbiology-Based Interventions

The microbiology lab in consultation with the stewardship program often implements the following interventions:

- **Selective reporting of antimicrobial susceptibility testing results:** Tailoring hospital susceptibility reports to show antimicrobials that are consistent with hospital treatment guidelines or recommended by the stewardship program.
- **Comments in microbiology reports:** For example, to help providers know which pathogens might represent colonization or contamination.

Nursing-Based Interventions

Bedside nurses often initiate the following interventions:

- **Optimizing microbiology cultures:** Knowing proper techniques to reduce contamination and indications for when to obtain cultures, especially urine cultures.
- **Intravenous to oral transitions:** Nurses are most aware of when patients are able to tolerate oral medications and can initiate discussions on switching to oral antimicrobials.
- **Prompting antimicrobial reviews (timeouts):** Nurses often know how long a patient has been receiving an antimicrobial and when laboratory results become available. They can play a key role in prompting reevaluations of therapy at specified times, such as after two days of treatment or when culture results are available.

Resources

- Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis. April 2016:ciw118. doi:10.1093/cid/ciw118. www.ncbi.nlm.nih.gov/27080992/
- Lee TC, Frenette C, Jayaraman D, et al. Antibiotic self-stewardship: Trainee-led structured antibiotic time-outs to improve antimicrobial use. *Ann Intern Med.* 2014;161(10 Suppl):S53-S58. www.ncbi.nlm.nih.gov/pubmed/25402404.
- Bartlett JG, Gilbert DN, Spellberg B . Seven ways to preserve the miracle of antibiotics. *Clin Infect Dis.* 2013;56(10):1445-1450. www.academic.oup.com/cid/article/56/10/1445/405531.
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- Spellberg B. The new antibiotic mantra—"Shorter is better." *JAMA Intern Med*. 2016;176(9):1254-1255. www.jamanetwork.com/journals/jamainternalmedicine/article-abstract/2536180.

Treatment Guidelines

- IDSA Practice Guidelines: www.idsociety.org/practiceguidelines#/date_na_dt/DESC/0/+/.
- Sanford Guide. The Sanford Guide to Antimicrobial Therapy 2019. Perryville, VA: Sanford Guide; 2019.
- Shales DM, Gerding DN, John JF Jr, et al. Society for Healthcare Epidemiology of America and Infectious Diseases Society of America Joint Committee on the prevention of antimicrobial resistance: Guidelines for the prevention of antimicrobial resistance in hospitals. 1997;18(4):275-291. www.ahaphysicianforum.org/resources/appropriate-use/antimicrobial/content%20files%20pdf/SHEA-Prevention-Guideline-1997.pdf.
- Liu C, Bayer A, Cosgrove SE, et al. Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant *Staphylococcus aureus* infections in adults and children. *Clin Infect Dis.* 2011;52(3):e18-e55. www.academic.oup.com/cid/article/52/3/e18/306145.
- Solomkin JS, Mazuski JE, Bradley JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: Guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Clin Infect Dis.* 2010;50(2):133-164. www.ncbi.nlm.nih.gov/pubmed/20034345/.
- Pappas PG, Kauffman CA, Andes DR, et al. Clinical practice guideline for the management of candidiasis: 2016 update by the Infectious Diseases Society of America. *Clin Infect Dis*. 2016;62(4):e1-e50. www.idsociety.org/practice-guideline/candidiasis/.
- McDonald CL, Gerding DN, Johnson S, et al. Clinical practice guideline for management of *Clostridium difficile*. 2018;66(7):e1-e48. www.idsociety.org/practice-guideline/clostridium-difficile/.
- CDC. Facility Guidance for Control of Carbapenem-Resistant Enterobacteriaceae (CRE) - November 2015 Update CRE Toolkit. Atlanta, GA: CDC. 2015. www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf.

5. Tracking

Measurement is critical to identify opportunities for improvement and to assess the impact of interventions. Measurement of antimicrobial stewardship interventions may involve evaluation of both processes and outcomes.

- **Antimicrobial Use Measures**

- It is important for hospitals to monitor and benchmark antimicrobial use by electronically reporting to the National Healthcare Safety Network (NHSN) Antimicrobial Use (AU) Option.
- The NHSN AU Option provides rates of antimicrobial use expressed as days of therapy (DOTs) per days present for nearly all antimicrobials for individual inpatient care locations, selected outpatient care locations, and for the entire hospital.
- The AU option also provides a risk-adjusted benchmark of antimicrobial use referred to as the Standardized Antimicrobial Administration Ratio or SAAR.
- Benchmarking has proven to be a powerful tool in hospital quality improvement and stewardship programs are using the NHSN AU Option to both inform and assess interventions.

- **Outcome Measures**
  - Length of stay
  - Antimicrobial resistance, focusing on hospital-onset infections
  - Adverse drug reactions (rates)
  - Hospital-onset *C. difficile* infection rates
  - Hospital readmissions for selected infections (SSTI, pneumonia, pyelonephritis)
  - Antimicrobial costs
- **Process Measures for Quality Improvement**

  Process measures can focus on the specific interventions being implemented at the hospital. Priority process measures include:

  - Tracking the types and acceptance of recommendations from prospective audit and feedback interventions, which can identify areas where more education or additional focused interventions might be useful.
  - Monitoring of preauthorization interventions by tracking agents that are being requested for certain conditions and ensuring that preauthorization is not creating delays in therapy.
  - Monitoring adherence to facility-specific treatment guidelines. If feasible, consider tracking adherence by each prescriber.

Resources

- Septimus E. Antimicrobial stewardship—Qualitative and quantitative outcomes: The role of measurement. *Curr Infect Dis Rep.* 2014;16(11):433. www.link.springer.com/article/10.1007%2Fs11908-014-0433-x.
- CDC. Strategies to Assess Antibiotic Use to Drive Improvements in Hospitals. www.cdc.gov/antibiotic-use/healthcare/pdfs/Strategies-to-assess-antibiotic-use-in-hospitals-508.pdf.
- CLSI M100-ED29: 2019 Performance Standards for Antimicrobial Susceptibility Testing, 29th Edition. www.em100.edaptivedocs.net/GetDoc.aspx?doc=CLSIM100ED29:2019&scope=user.
- National anaerobic antibiogram can be found in Appendix D. Cumulative Antimicrobial

Susceptibility Report for Anaerobic Organisms.

- Arizona Department of Health Services Antibiogram Toolkit. www.azdhs.gov/documents/preparedness/epidemiology-disease-control/healthcare-associated-infection/advisory-committee/antimicrobial-stewardship/antibiogram-toolkit.pdf.

6. Reporting

Antimicrobial stewardship programs should provide regular updates to prescribers, pharmacists, nurses, and leadership on process and outcome measures that address both national and local issues, including antimicrobial resistance.

- Antimicrobial resistance information should be prepared in collaboration with the hospital's microbiology lab and infection control and health care epidemiology department.
- Findings from medication use evaluations along with summaries of key issues that arise during prospective audit and feedback reviews and preauthorization requests can be especially useful to share with prescribers.
- Sharing facility-specific information on antimicrobial use is a tool to motivate improved prescribing, particularly if wide variations in the patterns of use exist among similar patient care locations.
- Summary information on antimicrobial use and resistance along with antimicrobial stewardship program work should be shared regularly with hospital leadership and the hospital board.

Methods to Collect Data

- Medication Administration Record Data
  - Best data to show if a patient receives an antimicrobial. The data are recorded often through bar code medication administration.
- NHSN Antimicrobial Use and Resistance Modules
  - Through the National Healthcare Safety Network (NHSN), health care facilities can now electronically monitor antimicrobial resistance and antimicrobial prescribing data. The data would be provided to the CDC and could allow for benchmarking antimicrobial use and resistance data.
  - Participation in these modules would also provide the participating institution with SAARs (refer to Process Measures located under Tracking Data).
- Pharmacy Dispensing Data
- Pharmacy Charge Data

Notes:

For those seeking to establish an ASP at their institution, several hospitals already utilize these tools for non-stewardship purposes:

- Infection Control – surveillance and epidemiology
- Pharmacy – workflow optimization
- Microbiology – antibiogram development/maintenance

Check with the departments in your hospital to determine if access can also be obtained for ASP purposes; this is one way to offset ASP start-up expenditures.

Resources

- Ibrahim OM, Polk RE. Benchmarking antimicrobial drug use in hospitals. *Expert Rev Anti Infect Ther.* 2012;10(4):445-457. www.tandfonline.com/doi/full/10.1586/eri.12.18.
- Septimus E. Antimicrobial stewardship—Qualitative and quantitative outcomes: The role of measurement. *Curr Infect Dis Rep.* 2014;16(11):433. www.link.springer.com/article/10.1007%2Fs11908-014-0433-x.
- Cosgrove SE, Patel A, Song X, et al. Impact of different methods of feedback to clinicians after post-prescription antimicrobial review based on the Centers for Disease Control and Prevention's 12 Steps to Prevent Antimicrobial Resistance Among Hospitalized Adults. *Infect Control Hosp Epidemiol*. 2007;28(6):641-646. www.doi.org/10.1086/518345.
- Lines TH, Nesbitt WJ, Nelson GE. Driving antimicrobial use improvement: Attitudes of providers of adult hospital care on optimal attribution and feedback. *Infect Control Hosp Epidemiol*. 2018;39(8):983-985. www.doi.org/10.1017/ice.2018.113.

NHSN Report Examples:

- AU line list: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-LineList.pdf.
- AU rate table by location: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-RateTables-Location.pdf.
- AU rate table facility-wide: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-RateTables-FACWIDEIN.pdf.
- AU bar chart: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-BarChart.pdf.
- AU standardized antimicrobial administration ratio (SAAR) table: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-SAARTables.pdf.
- AU SAAR bar chart by location: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-qrg-saar-bartable-location-508.pdf.
- AR event line list: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-QRG-LineList.pdf.
- AR bar chart: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-barchart-508.pdf.
- AR facility-wide antibiogram: www.cdc.gov/nhsn/acute-care-hospital/aur/index.html.

- AR denominator line list: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-denom-linelist-508.pdf.
- AR organisms line list: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-organisms-linelist-508.pdf.
- AR organisms frequency table: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-freq-508.pdf.
- AR organisms rate table: www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-ratetable-508.pdf.

7. Education

Education is a key component of comprehensive efforts to improve hospital antimicrobial use. It is most effective when paired with interventions and measurement of outcomes.

There are also a variety of educational materials on hospital antimicrobial use and stewardship available from the Agency for Healthcare Research and Quality's Safety Program for Improving Antimicrobial Use.

Antimicrobial Resistance Resources for Health Care Providers

- **Online Courses**
  - Centers for Disease Control and Prevention (CDC) online training on antibiotic stewardship Section 1, Modules 1, 2, and 3 – Antibiotic Resistance, Antibiotic Stewardship, and Antibiotic Adverse Events
  - University of Gothenburg (Sweden); Centre for Antibiotic Resistance Research and Department of Chemistry and Molecular Biology; The Problem of Antibiotic Resistance
  - Global Health eLearning Center
    - Antimicrobial Resistance (Part 1)
    - Antimicrobial Resistance (Part 2)
- **Online Slides and Lectures**
  - Wake Forest School of Medicine; Center for Antimicrobial Utilization, Stewardship, and Epidemiology (CAUSE)
  - Wake Forest School of Medicine; Antimicrobial Stewardship Curriculum
  - NHS Health Education England; Reducing Antimicrobial Resistance: An Introduction
  - George Mason University Schar School of Policy and Government; Module 1: Anti Microbial Drug Resistance
  - Harvard T. H. Chan School of Public Health; Antibiotic Resistance (Lauren Cowley)
- **General Resources**
  - Centers for Disease Control and Prevention (CDC) Antibiotic/ Antimicrobial Resistance (AR/ AMR)

- World Health Organization (WHO)
  Antimicrobial Resistance
- World Health Organization (WHO)
  Quiz: How much do you know about antibiotic resistance?
- New York State Department of Health
  Video: Educating Patients about Antibiotic Use

Antimicrobial Stewardship Resources

- **Online Courses**
  - Centers for Disease Control and Prevention (CDC) Training on Antimicrobial Stewardship
  - World Health Organization (WHO); Antimicrobial Stewardship: A competency-based approach
  - Stanford University School of Medicine; Antimicrobial Stewardship: Improving Clinical Outcomes by Optimization of Antibiotic Practices
  - Optimizing Antimicrobial Therapy with Timeouts
  - To Prescribe or Not to Prescribe? Antibiotics and Outpatient Infections
- **Online Slides and Lectures**
  - University of Pennsylvania; Antimicrobial Stewardship Education
  - The Ohio State University; Webcast: Antibiotic Stewardship
  - Peds University: Antimicrobial Stewardship for the Outpatient Pediatric Provider
- **Patient Resources**
  - The ABC's of Antibiotics
  - Viruses or Bacteria: What's got you sick?
  - Antibiotics Aren't Always the Answer
  - You've been Prescribed an Antibiotic in the Hospital for an Infection
  - Frequently asked questions about *Clostridioides difficile*

Antimicrobial Stewardship Core Elements and Toolkit Links

- **Critical Access and Rural Hospitals**
  - Implementation of Antibiotic Stewardship Core Elements at Small and Critical Access Hospitals
  - Jump Start Stewardship - Implementing Antimicrobial Stewardship in a Small, Rural Hospital
  - Antimicrobial Stewardship Programs - a Toolkit for Critical Access Hospitals in Kansas; Kansas Department of Health and Environment
- **Long-Term Care**

- The Core Elements of Antibiotic Stewardship for Nursing Homes
- Nursing Home Antimicrobial Stewardship Guide – Toolkits; Agency for Healthcare Research and Quality (AHRQ)
- Minnesota Antimicrobial Stewardship Program Toolkit for Long-Term Care Facilities; Minnesota Department of Health
- Antimicrobial Stewardship Toolkit - Best Practices From the GNYHA/UHF Antimicrobial Stewardship Collaborative; Greater New York Hospital Association and United Hospital Fund
- Rochester Patient Safety Collaborative; University of Rochester (New York)

➢ **Outpatient**
- The Core Elements of Outpatient Antibiotic Stewardship
- Antibiotic Stewardship Toolkit – Implementing the Core Elements of Outpatient Stewardship in Your Facility; Health Quality Innovators (HQI), QIN/QIO for Maryland and Virginia
- Lake Superior Quality Innovation Network, QIN/QIO for Michigan, Minnesota, and Wisconsin
- Kentucky Outpatient Antimicrobial Stewardship Implementation Workbook; Kentucky Antibiotic Awareness; University of Louisville, Norton Children's Hospital, Kentucky Cabinet for Health and Family Services
- MITIGATE Antimicrobial Stewardship Toolkit – for implementation in ED and urgent care settings; Society for Healthcare Epidemiology of America

➢ **Resource-Limited Settings**
- The Core Elements of Human Antibiotic Stewardship Programs in Resource-Limited Settings: National and Hospital Levels