



Antibiotic Stewardship in Acute Care: A Practical Playbook

NATIONAL QUALITY FORUM
NATIONAL QUALITY PARTNERS
ANTIBIOTIC STEWARDSHIP ACTION TEAM



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THE NATIONAL URGENCY FOR OPTIMAL ANTIBIOTIC USE

The discovery of antibiotics over the past century has changed the field of medicine beyond any other discovery to date. Because of the availability of these drugs, we are able to cure many serious infections that previously would have been untreatable and, in many cases, deadly. Unfortunately, overuse and misuse of antibiotics have resulted in increasing resistance, creating the real and growing threat of new “super-bugs” that are increasingly difficult to treat. Studies indicate that 30-50 percent of antibiotics prescribed in hospitals are unnecessary or inappropriate.¹ Misuse occurs in healthcare settings for a variety of reasons, including use of antibiotics when not needed, continued treatment when no longer necessary, wrong dose, use of broad-spectrum agents to treat very susceptible bacteria, and wrong antibiotic to treat an infection.²

Driven in part by antibiotic overuse and misuse, increasing antibiotic resistance is an urgent concern for the healthcare field as well as for public health and national security. According to the U.S. Centers for Disease Control and Prevention (CDC), drug-resistant bacteria cause 23,000 deaths and 2 million illnesses each year.³ Avoidable costs from antibiotic misuse range from \$27 billion to \$42 billion per year in the United States.⁴ Changes to clinical practice patterns to promote appropriate use of antibiotics are now essential.

In September 2014, the President’s Council of Advisors on Science and Technology (PCAST) released its *Report to the President on Combating Antibiotic Resistance*. This report was followed by the President’s Executive Order which calls for the Department of Health and Human Services (HHS) to promote the implementation of robust antibiotic stewardship programs (ASPs) across healthcare facilities.⁵ In March 2015, the White House issued its National Action Plan for Combating Antibiotic-Resistant Bacteria, which set forth goals to slow the emergence and spread of resistant bacteria and to strengthen antibiotic stewardship in inpatient, outpatient, and long-term

care settings. Stewardship programs are one of the most critical mechanisms for reducing antibiotic resistance.

ASPs can optimize treatment of infections and antibiotic use—with the goal to provide every patient with the right antibiotics, at the right time, at the right dose, and for the right duration—to reduce adverse events associated with antibiotics and improve patient outcomes.^{6,7} ASPs also reduce hospital *C. difficile* rates^{8,9,10} and antibiotic resistance.^{11,12} In 2014, the CDC recommended that all acute-care hospitals in the United States have an ASP to lead efforts to improve antibiotic use. Additionally, the American Hospital Association has identified antimicrobial stewardship as one of the top five areas for improvement in hospital resource utilization. To help hospitals implement stewardship programs, the CDC developed *The Core Elements of Hospital Antibiotic Stewardship Programs*,¹³ which outlines seven key components that have been associated with successful stewardship programs.

Based on these *Core Elements*, this *Playbook* intends to provide concrete strategies and suggestions for organizations committed to

implementing successful ASPs in acute-care hospitals. The National Quality Forum (NQF) convened key experts from across the country to develop this resource; thus, the *Playbook* offers a range of potential solutions and practices that have been successfully implemented in various acute-care situations and settings. This *Playbook* is modeled on the *Playbook for the Successful Elimination of Early Elective Deliveries*, produced by the National Quality Forum's Maternity Action Team in 2014. The work of this Action Team contributed to the reduction in early elective

deliveries by more than 70 percent nationwide.

In response to the antibiotic crisis, the public and private sectors are galvanizing around approaches to increase incentives for ASPs that optimize antibiotic use. Organizations involved in NQF's initiative are moving forward with programmatic changes intended to stimulate broader adoption of stewardship programs. The *Playbook* makes recommendations for organizations, including hospitals, accreditation bodies, and patient and consumer groups, to enhance their stewardship activities to prepare for these changes.

NQF EFFORTS IN ANTIBIOTIC STEWARDSHIP

NQF's initiative to promote appropriate antibiotic use is spearheaded by National Quality Partners (NQP), an effort that aims to galvanize NQF's more than 430 organizational members to take action on healthcare quality issues of national importance. Through virtual and in-person forums and ongoing strategic partnerships, NQP provides opportunities to address complex problems that encourage collaboration, learning, and most importantly, action.

NQP's Antibiotic Stewardship Action Team addresses the national priority of antibiotic stewardship to improve public health and patient safety. Over the past year, NQP has engaged public- and private-sector leaders and experts from over 40 organizations to develop a common agenda and identify and implement strategies to improve antibiotic practices among providers, healthcare organizations, and local communities. While measures related to antibiotic stewardship are improving, success also depends on culture and behavior change. The collective engagement of the Action Team intends to provide guidance to change provider practices and drive change more quickly.

Co-chaired by Ed Septimus, MD, FIDSA, FACP, FSHEA, medical director, Infection Prevention and Epidemiology Clinical Services Group, Hospital Corporation of America, and Arjun Srinivasan, MD

(CAPT, USPHS), associate director for healthcare associated infection prevention programs, Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, the Action Team has worked to provide guidance and feedback on current antibiotic stewardship metrics, recommend practices for incorporating antibiotic stewardship into accountability programs, and promote tools and resources to support stewardship.

The Action Team hosted the following events:

- Monthly Action Team Calls, March 2015-May 2016
- Antibiotic Stewardship Action Team Kickoff Virtual Forum, May 20, 2015
- The Role of Payers and Providers in Promoting Antibiotic Stewardship, August 13, 2015
- Antibiotic Stewardship Tweet Chat, November 19, 2015
- Developing a Practical Playbook to Advance Effective Antibiotic Stewardship In-Person Forum, December 3, 2015
- NQF Annual Conference Breakout Session on Advancing Antibiotic Stewardship, April 7, 2016
- Playbook Launch Webinar, May 25, 2016

NQF supports the National Action Plan and is also a partner in the White House's antibiotic resistance initiative. NQF hopes that NQP's collaborative work will accelerate the adoption of antibiotic stewardship programs and enhance the use of quality measures and accountability levers to affect antibiotic prescribing patterns to improve patient outcomes.

The NQP Antibiotic Stewardship Action Team led the development of the *Playbook* in conjunction with subject matter experts. The Action Team planned the content and outline over a series of monthly calls, which culminated in a December 2015 forum. NQF designed this meeting for key stakeholders to offer feedback on the *Playbook* concept and to provide practical guidance to support implementation of the CDC's *Core Elements*. Following the meeting, the Action Team Co-Chairs and NQF staff drafted the

Playbook and reviewed it with the Action Team and subject matter experts on feedback calls and by email. This *Playbook* reflects the collaboration between NQP and key stakeholders on how to implement a successful antibiotic stewardship program, potential barriers and solutions, and suggested tools and resources as well as potential measurement approaches and future directions.

The views and recommendations expressed in this publication were developed in collaboration with the Action Team and its individual members. These views have not been endorsed by and are not the expressed opinion held by the National Quality Forum.

The findings and conclusions of this report are those of the authors and do not necessarily reflect the official position of the Centers for Disease Control and Prevention.

A PRACTICAL APPROACH TO ANTIBIOTIC STEWARDSHIP

Overview of CDC Core Elements and Rationale

The *Playbook* seeks to provide concrete strategies and suggestions for organizations committed to implementing successful antibiotic stewardship programs in acute-care hospitals.

In 2014, the CDC recommended that all acute-care hospitals implement antibiotic stewardship programs in order to meet the urgent need to improve antibiotic use in hospitals. The CDC's *Core Elements* of ASPs are outlined below, and each links to the corresponding section in the *Playbook*.

Overview of [CDC Core Elements](#):^{14,15}

1. **Leadership Commitment:** Dedicate necessary human, financial, and information technology resources.
2. **Accountability:** Appoint a single leader responsible for program outcomes who is accountable to an executive-level or patient quality-focused hospital committee. Experience with successful programs shows that a physician leader is effective.
3. **Drug Expertise:** Appoint a single pharmacist leader responsible for working to improve antibiotic use.
4. **Action:** Implement at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e., “antibiotic time out” after 48 hours).
5. **Tracking:** Monitor process measures (e.g., adherence to facility-specific guidelines, time to initiation or de-escalation), impact on patients (e.g., *Clostridium difficile* infections, antibiotic-related adverse effects and toxicity), antibiotic use, and resistance.
6. **Reporting:** Report the above information regularly to doctors, nurses, and relevant staff.
7. **Education:** Educate clinicians about disease state management, resistance, and optimal prescribing.

How to Use the Playbook

For each CDC *Core Element*, the *Playbook* includes a brief rationale and overview, examples for implementation, potential barriers and suggested solutions, and suggested tools and resources. The examples for implementation represent a spectrum of activities. To the extent possible, the implementation examples progress from basic to intermediate to advanced approaches—though this categorization is approximate. A hospital need not pursue approaches in the order indicated by the categories to which they are assigned herein.

The *Playbook* attempts to lay out the implementation examples as a broad range of what is possible and achievable, while recognizing that what will be effective depends heavily on local circumstances. “Potential barriers” and “suggested solutions” are outlined in the section directly below the examples of implementation, and the links to all mentioned tools are at the end of each section. Resources include peer-reviewed journal articles, published statements and guidelines from stakeholders, resources from public health organizations, and sample hospital tools. Hyperlinks for each resource or tool are included in the Appendix by section of the *Playbook*.

The *Playbook* intends to provide practical guidance on options for hospitals to implement in creating or strengthening antibiotic stewardship programs, using the resources available to them. The document is not a list of “must do’s” to be completed. Instead, the *Playbook* lays out a variety of options from which to choose depending on local context, resources, and needs. While the *Playbook* is not a checklist, it does strive to provide leadership guidance to design an effective, high-quality, and sustainable antibiotic stewardship program.

The strategies in the *Playbook* not only pertain to antibacterials but also other antimicrobials such as drugs to fight viruses (antivirals), parasites (antiparasitics), and fungi (antifungals).

Core Element 1: Leadership Commitment

To succeed, antibiotic stewardship programs need clear support from hospital leadership. Leadership commitment can be demonstrated in many ways, and the board, executive team, leadership, and professional staff must all clearly support that commitment. Dedicating necessary human, financial, and information technology resources is a key part of demonstrating an organization's commitment to effective stewardship. Here are examples of core actions that could be taken to demonstrate leadership commitment, examples of implementation, and identified barriers with potential solutions.

- Facility leadership should provide a visible, written statement of support for the antibiotic stewardship program (ASP). Formal statements (e.g., a policy or statement approved by the board) carry more weight with facility staff than less formal communications (e.g., a newsletter column).
- Facility leadership should provide support (financial and time) for training and education on antibiotic stewardship (AS), ensure adequate staffing, and establish a clear communication strategy on AS.
- Facility leadership should provide sustained financial support and ensure that ASP team leaders have time to perform the functions of the program.

Examples of Implementation

Basic

- Issue a formal board-approved statement on the importance of the ASP and include in annual report.
- Develop and distribute a newsletter column from the CEO and CMO and/or chief of the medical staff highlighting the ASP and their commitment to improving antibiotic use.
- Dedicate specific salary support for ASP leaders based on size and population of the hospital.
- Include specific time commitment (%FTE or hours/week, hours/month) in the job description of ASP leaders, and articulate targets and goals.
- Support funding for remote consultation or telemedicine with experts in antibiotic stewardship (e.g., infectious diseases physicians and pharmacists) if local resources are not available.
- Communicate regularly the importance of improving antibiotic use and the hospital's commitment to antibiotic stewardship.
- Share stories, speakers, and other resources that highlight how ASPs can improve patient outcomes.
- Include ASP outcome measures in the facility's strategic dashboard and update leadership regularly on meeting those goals.
- Integrate ASP activities into quality improvement and/or patient safety initiatives and reports to medical executives.
- Include antibiotic stewardship in ongoing provider education programs and annual competencies.

Advanced

- Ensure that ASP leaders have training in measuring and improving antibiotic use.
- Prioritize funding for information technology

Intermediate

- Designate or appoint a hospital executive to serve as a "champion" of the ASP.

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| <p>assistance to support ASP initiatives.</p> <ul style="list-style-type: none"> • Support access to and availability of microbiology data and laboratory resources for AS efforts. • Develop and implement an antibiotic stewardship strategy and action plan that cascades from the C-suite through individual department policies | <p>to all leaders and prescribers.</p> <ul style="list-style-type: none"> • Create financial incentives for units or departments to improve antibiotic use. • Ensure necessary support from other disciplines (e.g., quality improvement staff, laboratory staff, IT, and nurses) and specify their responsibilities to support the ASP. IT resources are often especially important | <p>and challenging, and should be made available by leadership.</p> <ul style="list-style-type: none"> • Support efforts and policies to hold providers accountable for improving antibiotic use. • Engage patients or patient advocates in order to include the broader community in establishing accountability. |
|--|--|--|

Potential Barriers Suggested Solutions

Low Support of ASP by Leaders

Suggested Solutions

- Direct leaders to statements on the importance of antibiotic stewardship programs from groups such as the American Hospital Association, the Institute for Healthcare Improvement, and The Leapfrog Group, which are recognized by hospital C-suite leaders.
- Develop and advance the business case to show that ASPs provide high value by improving patient outcomes, the patient experience, and reducing adverse effects, which in turn decreases costs and results in financial savings.
- Refer to key national reports on the importance of antibiotic stewardship and antibiotic resistance.
- Share data on hospital problem areas such as high antibiotic resistance rates, *C. difficile* infection rates, inappropriate antibiotic use, readmissions due to infections, etc. *C. difficile* rates can be especially influential since they are part of the Centers for Medicare & Medicaid Services Inpatient Quality Reporting Program.

Low Awareness of ASP at Board/C-Suite Levels

Suggested Solutions

- Provide leaders with data, narratives, and expert-led presentations on ASP benefits (e.g., reductions in *C. difficile* infections, improved infection cure rates, and reductions in antibiotic resistance).
- Engage patients and advocates to share stories about *C. difficile* infections and antibiotic-resistant organisms and their impact on patients and families.

Competing Priorities or “Initiative Fatigue”

Suggested Solutions

- Direct leaders to proposed regulatory and accreditation requirements (i.e., from The Joint Commission).
- Emphasize that ASP implementation is a workforce and patient safety issue as well as a patient experience issue.
- Discuss the potential impact on the hospital brand if AS is not prioritized.
- Gain efficiencies by incorporating stewardship efforts into other quality improvement efforts (e.g., *C. difficile*, sepsis).

Suggested Tools and Resources

Hospital Resources

- Centers for Disease Control and Prevention (CDC). **Antimicrobial Management Program Gap Analysis Checklist**. Atlanta, GA: CDC; 2010.

Evidence on Impact of ASPs

- Schuts EC, Hulscher ME, Mouton JW, et al. **Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis**. *Lancet Infect Dis*. 2016; S1473-3099(16):00065-7. [Epub ahead of print].

Business Case for ASP

- Greater New York Hospital Association (GNYHA), United Hospital Fund. Appendix M: Theoretical Monthly Savings of an Antimicrobial Stewardship Program. In: **Antimicrobial Stewardship Toolkit**. New York, NY: GNYHA; 2015:77.
- Anthem. **Quality-In-Sights®: Hospital Incentive Program (Q-HIP)**.
- Kravitz GR. **Making the Business Case for ASP: Taking It to the C-Suite** [PowerPoint]. St. Paul, MN: St. Paul Infectious Disease Associates; 2015.
- Centers for Disease Control and Prevention (CDC). **Get Smart About Antibiotics: Save Money With Antibiotic Stewardship Fact Sheet**. Atlanta, GA: CDC; 2015.
- Lynch JB. **Antimicrobial Stewardship - A Value-Driven Means to Improved Patient Outcomes and Reduce Costs**. *HFM Magazine*. 2016; March: 38-41.

- Rodriguez, AG. **A virtual ID Specialist: Antimicrobial stewardship via telemedicine**. Becker's Health IT & CIO Review. November 20, 2015.

Key National Resources

- Centers for Disease Control and Prevention (CDC). **Core Elements of Hospital Antibiotic Stewardship Programs**. Atlanta, GA: CDC; 2014.
- The White House. **National Strategy for Combating Antibiotic-Resistant Bacteria**. Washington, DC: White House; 2014.
- The White House. **National Action Plan for Combating Antibiotic-Resistant Bacteria**. Washington, DC: White House; 2015.
- Centers for Disease Control and Prevention (CDC). Get smart for healthcare: **overview and evidence to support stewardship**.
- Spellberg B, Srinivasan A, Chambers HF. **New societal approaches to empowering antibiotic stewardship**. *JAMA*. 2016;315(12):1229-1230.

Implementation Tools

- American Hospital Association (AHA), American Hospital Association's Physician Leadership Forum. **Appropriate Use of Medical Resources**. **Antimicrobial Stewardship Toolkit**. Washington, DC: AHA; 2014.
- The Society for Healthcare Epidemiology of America. **Antimicrobial stewardship: implementation tools & resources**.

Regulatory and Accreditation Requirements

- Joint Commission Resources**.

Core Element 2: Accountability

Appointing a leader or co-leaders (one should be a physician, if possible), who are responsible for program outcomes and whose effectiveness is assessed through clear performance standards, provides accountability for antibiotic stewardship.

- The antibiotic stewardship program (ASP) should have a designated leader or co-leaders who are accountable to the hospital leadership for meeting goals and targets. Published studies and guidelines have recommended physicians with training in infectious diseases as effective ASP leaders.
- Criteria for a physician and/or pharmacy leader should include expertise in antibiotic use, training in stewardship, leadership skills, respect from peers, and good team skills.

Examples of Implementation

Basic

- Medical staff and C-suite identify a physician and pharmacy leader with expertise in antibiotic use and training in stewardship responsible for leading the ASP. Physicians and pharmacists trained in infectious diseases have been shown to be effective, especially in larger hospitals.
- Identify a nurse practitioner with expertise in antibiotic use if a physician and/or pharmacy leader is/are not available.
- Ensure a collaborative approach between physicians and pharmacists.

Intermediate

- Ensure the ASP leader has specific training in antibiotic stewardship (e.g., certification program or training course).
- Hold the ASP leader accountable for specific stewardship outcome measures.
- Include documentation of ASP outcome measures in performance evaluations.
- Ensure the ASP leader actively engages other groups in stewardship efforts (e.g., emergency departments, hospitalists, surgeons, intensivists, and nurses).

- Ensure the ASP leader actively engages in any antibiotic use related improvement efforts (e.g., peri-operative antibiotic use and early recognition and treatment of sepsis).

Advanced

- Tie established metrics to performance reviews and/or incentive payments for key leaders (e.g., appropriate antibiotic use and antibiotic timing for surgical prophylaxis and sepsis).
- Consider hospital quality measures, such as Standardized Antibiotic Administration Ratio (SAAR) and *C. difficile* infection (CDI) rates as part of performance measures for ASP.

Potential Barriers Suggested Solutions

Inability to Find a Qualified Leader

Suggested Solutions

- Support appropriate training for the designated leader.
- Contract with infectious diseases physician or pharmacist groups (even part-time, off-site

groups, or telemedicine) to provide support to the ASP.

- Join a regional collaborative for stewardship projects and seek expertise from that network when additional expertise is needed (especially in rural areas).

Leaders Who Are Not Effective Stewards

Suggested Solutions

- Provide antibiotic stewardship training opportunities for ASP program leaders.
- Make performance-based contracts (e.g., co-management agreements) to ensure leaders who are accountable.
- Provide feedback and antibiotic usage reports to program leaders.

Fear of Disciplining Rogue Providers/Habitual Offenders

Suggested Solutions

- Ensure the program leader has good communication skills and works with providers in productive ways (e.g., one-on-one mentoring and inviting “problem” prescribers to become part of problem-solving efforts).
- Establish a policy that defines noncompliance with stewardship program recommendations and corrective actions.
- Ensure that leader(s) of the ASP are well supported by facility leadership in efforts to address problem prescribers.

Nonphysicians Sometimes Not Included in ASP Outreach Efforts

Suggested Solutions

- Engage non-physician prescribers in all AS efforts.

Suggested Tools and Resources

Guidelines and Statements

- 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*. 2016;62(10):e51-e77.
- The Infectious Diseases Society of America. [Practice guidelines](#).

- Provide antibiotic stewardship training opportunities for non-physician prescribers.
- Develop AS competencies for all healthcare professionals (e.g., nurses, physician assistants, physical therapists, etc.) that must be renewed on an annual basis.

Lack of Coordination of Different Disciplines and Silos of Care

Suggested Solutions

- Establish multidisciplinary ASP team (including physicians, pharmacists, lab, and nursing staff) with clear team goals and metrics.
- Include champions in the ASP team who represent high-impact areas for stewardship (e.g., critical care, surgery, medicine, primary care, emergency medicine, and pediatrics).
- Align the ASP with a C-suite champion and the patient safety/quality improvement department to elevate AS and remove silos.
- Ensure an AS representative is integrated into each “silo” of care (e.g., multidisciplinary improvement efforts such as improved sepsis management).

Shifting Priorities/Responsibilities

Suggested Solution

- Protect time of the leader(s) accountable for antibiotic stewardship activities.

- The Society for Healthcare Epidemiology of America. [SHEA guidelines and expert guidance documents](#).
- [Policy Statement](#) on Antimicrobial Stewardship by the [Society for Healthcare Epidemiology of America](#) (SHEA), the [Infectious Diseases Society of America](#) (IDSA), and the [Pediatric Infectious Diseases Society of America](#) (PIDS). *Infect Control Hosp Epidemiol*. 2012;33(4):322-327.

Certification Programs and Courses

- MAD-ID. Antimicrobial stewardship training programs.
- Pediatric Infectious Diseases Society. Annual International Pediatric Antimicrobial Stewardship Conference website.
- The Society for Healthcare Epidemiology of America (SHEA). Training Course.
- IDWeek **Premeeting Workshops**.
- Society of Infectious Disease Pharmacists (SIDP). Antimicrobial stewardship. **A certificate program for pharmacists**.
- Stanford Medicine Online Continuing Medical Education (CME) Online CME Course. Antimicrobial stewardship: optimization of antibiotic practices.

Remote Access/Telemedicine

- Agency for Healthcare Research and Quality (AHRQ) Innovations Exchange. **Telemedicine-based antimicrobial stewardship program** improves prescribing, reduces bacterial

resistance to antibiotics at rural hospital. Service delivery innovation profile.

Collaboratives

- Colorado Hospital Association (CHA). **Antimicrobial Stewardship Collaborative Commitment Letter**. Greenwood Village CO, CHA; 2015.
- Mack MR, Rohde JM, Jacobsen D, et al. Engaging hospitalists in antimicrobial stewardship: **lessons from a multihospital collaborative**. *J Hosp Med*. 2016;10.1002/jhm.2599 [epub ahead of print].

Metrics and Competencies

- 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.
- The Advisory Board. The Current State of Hospital Antibiotic Stewardship: **Findings from our Antibiotic Stewardship Program Survey**. Washington, DC: The Advisory Board; 2015.

Core Element 3: Drug Expertise

Dedicated staff with demonstrated drug expertise is critical to the success of antibiotic stewardship. Appointing a pharmacist leader to partner with the antibiotic stewardship program leader provides the expertise and accountability needed for a high-quality program.

- A pharmacist leader with expertise in antibiotic use is identified and is responsible for partnering with the antibiotic stewardship physician leader or physician champion to improve antibiotic use. Published studies and guidelines have recommended pharmacists with training in infectious diseases as effective ASP pharmacy leaders.
- Criteria for a pharmacy leader should include expertise in antibiotic use, training in stewardship, leadership skills, respect from peers, and good team skills.

Examples of Implementation

Basic

- Ensure there is a documented pharmacy leader with expertise in antibiotic stewardship; pharmacists with postgraduate training in infectious diseases have been shown to be effective, especially in larger hospitals.

Intermediate

- Provide training opportunities in antibiotic stewardship for a pharmacy leader (e.g., certificate programs).

Advanced

- Ensure the pharmacy leader engages and trains other

pharmacy staff in antibiotic use so that there is a broad pharmacy stewardship workforce (e.g., emergency departments, intensive care, pharmacists, and medical and surgical specialty pharmacists).

Potential Barriers and Suggested Solutions

Inability to Find a Qualified Pharmacist

Suggested Solution

- Consider options for potential offsite infectious diseases expert support for pharmacy staff (e.g., through telemedicine).

Insufficient Funding

Suggested Solution

- Provide hospital and pharmacy leadership with evidence of the value proposition realized by ASPs (especially pharmacy cost savings) and regulatory requirements.

Suggested Tools and Resources

Competencies

- 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.

Guidelines and Statements

- American Society for Health-System

Pharmacists (ASHP). **Statement** on the pharmacist's role in antimicrobial stewardship and infection prevention and control. **Antimicrobial stewardship resources.**

- Heil EL, Kuti JL, Bearden DT, et al. **The essential role of pharmacists in antimicrobial stewardship.** *Infect Control Hosp Epidemiol.* 2016; April 13:1-2 [epub head of print].

- **Society for Infectious Diseases Pharmacists (SIDP) website.**
- Society for Infectious Diseases Pharmacists (SIDP). **Software vendors who support the CDC antimicrobial use and resistance initiative.**
- Sanford Guide. **The Sanford Guide to Antimicrobial Therapy 2016.** Sperryville, VA: Sanford Guide; 2016.

Certification Programs and Courses

- MAD-ID. **Antimicrobial stewardship training programs.**
- Pediatric Infectious Diseases Society (PIDS) **Annual International Pediatric Antimicrobial Stewardship Conference** website.
- The Society for Healthcare Epidemiology of America (SHEA). **Training Course.**

- IDWeek **Premeeting Workshops.**
- Society of Infectious Disease Pharmacists (SIDP). Antimicrobial stewardship. **A certificate program for pharmacists.**
- **Stanford Medicine Online Continuing Medical Education (CME) Course.** Antimicrobial stewardship: optimization of antibiotic practices.

Remote Access/Telemedicine

- Agency for Healthcare Research and Quality (AHRQ) Healthcare Innovations Exchange. **Telemedicine-based antimicrobial stewardship program** improves prescribing, reduces bacterial resistance to antibiotics at rural hospital. Service delivery innovation profile.

Core Element 4: Actions to Support Optimal Antibiotic Use

Implementing at least one or more interventions to improve antibiotic use, such as the systematic evaluation of ongoing treatment need after a set period of initial treatment, is critical for an effective antibiotic stewardship program.

- The antibiotic stewardship program (ASP) identifies and implements one or more specific interventions to improve antibiotic use at the hospital. The intervention(s) should align with local needs (i.e., interventions address areas where evidence suggests room for improvement at the hospital). The interventions have measurable outcomes, which the ASP monitors and reports to hospital leadership and providers.

Examples of Implementation

Basic:

Systemwide Interventions

- Implement a policy for review of antibiotic orders for specified drugs by a physician or pharmacist based on local needs (also known as “prior approval”).
- Require documentation of diagnosis/indication, drug, dose, and duration for all antibiotic orders.
- Establish guidance for antibiotic allergy assessment (e.g., a penicillin allergy assessment protocol, including recommendations on which patients might benefit from skin testing).
- Develop facility-specific treatment recommendations based on national guidelines and local susceptibility data.
- Standardize order forms for common clinical syndromes based on facility guidelines.

Intermediate:

Patient-Specific Interventions

- Establish a process to review antibiotics prescribed after 48-72 hours (“antibiotic time-out” or “post-prescription review”). This might be done by the treating team and/or the ASP.
- Establish guidance on automatic changes from IV to oral dosing in identified situations.
- Establish guidance on dose adjustment for cases of organ dysfunction.
- Develop dose optimization recommendations, especially for organisms with reduced susceptibility.
- Build in automatic alerts for potentially duplicative drug therapy.
- Implement time-sensitive automatic stop orders for specified antibiotics (e.g., use of agents for surgical prophylaxis or empiric therapy).

- Ensure that the stewardship program works with the ICU to develop optimized antibiotic treatment protocols for possible sepsis cases.
- Ensure discussions of patient care (e.g., rounds) include information on antibiotics.

Advanced:

Diagnosis- and Infection-Specific Interventions

- Use real-time, rapid diagnostics such as rapid pathogen identification assays (e.g., influenza and MRSA) and biomarkers (e.g., procalcitonin) to improve appropriate antibiotic use.
- Assure timely and appropriate culture collection and transport.
- Realize important evidence-based opportunities and methods to improve antibiotic use for several infections and/or situations, e.g.:
 - Community-acquired pneumonia
 - Urinary tract infections

- | | | |
|---|--|---|
| - Skin and soft tissue infections | antibiotic therapy in new cases of CDI | - Inappropriate use of antibiotics with overlapping spectra |
| - Surgical prophylaxis | - Culture-proven invasive infections (e.g., bloodstream) | - Inappropriate treatment of culture contaminants |
| - Surgical site infections | - Intra-abdominal infections | - Inappropriate treatment of colonization |
| - Empiric treatment of suspected MRSA infections | - Sepsis | |
| - Critical evaluation of need for continued non-CDI | - <i>S. aureus bacteremia</i> (including central line) | |

Potential Barriers and Suggested Solutions

Providers and/or ASP Team Overwhelmed by Scope of Interventions

Suggested Solutions

- Meet with key stakeholders to survey areas of unmet need.
- Develop a priority matrix and start with one stewardship intervention based on the facility's local needs and available data and guidance in literature (e.g., surgical prophylaxis e-order set and community-acquired pneumonia); establish a sequential rollout that is inclusive of key stakeholders.
- Assess antibiotic use to look for areas where there is clear evidence of need for improvement (e.g., evaluate treatment of most commonly seen or most severe infections to identify areas for improvement).
- Engage bedside nurses in stewardship actions to help expand the stewardship workforce and the role of nurses, as they are first responders.

Resistance from Providers to Proposed Interventions

Suggested Solutions

- Provide provider-specific dashboards with de-identified peer group comparisons.
- Partner with providers to identify interventions that they think would be most helpful.
- Partner with providers to determine the best

ways to implement interventions into normal workflow.

- Participate in a regional/state collaborative to allow for peer benchmarking.

Providers Not Aware of Treatment Recommendations

Suggested Solutions

- Implement clinical decision support to ensure guidelines and recommended interventions are easily accessible.
- Embed clinical decision support tools in the electronic health record (e.g., best practice alerts and standardized antibiotic order sets).
- Provide regular antibiotic stewardship education to all relevant staff.
- Provide feedback to providers on compliance rates with recommendations.

“Alert Fatigue”

Suggested Solutions

- Select carefully and cascade alerts at the point of care.
- Filter alerts to ensure providers receive only the most important alerts.
- Work with electronic health record/clinical decision support system provider to increase sensitivity and specificity of alerts.

Suggested Tools and Resources

Audit Tools

- 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.
- Southwest Memorial Hospital Stewardship Committee. The 5Ds—Diagnosis/Indication; Drug; Dose; Duration; and De-escalation + Door for Choosing the Best Setting of Care **ASP documentation**. Houston, TX: Southwest Memorial Hospital; 2016.
- Society of Infectious Diseases Pharmacists (SIDP). **Software vendors** who support the CDC Antimicrobial Use and Resistance Initiative.
- Agency for Healthcare Research and Quality (AHRQ). **Toolkit for reduction of Clostridium difficile infections through antimicrobial stewardship**.
- 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.
- Society of Critical Care Medicine. **Surviving sepsis campaign guidelines**.
- Centers for Disease Control and Prevention (CDC). **Clinician guide for collecting cultures**.
- Sanford Guide. **The Sanford Guide to Antimicrobial Therapy 2016**. Perryville, VA: Sanford Guide; 2016.

Journal Articles

- Bartlett JG, Gilbert DN, Spellberg B. **Seven ways to preserve the miracle of antibiotics**. *Clin Infect Dis.* 2013;56:(10)1445-1450.
- Branche AR, Walsh EE, Vargas R, et al. **Serum procalcitonin measurement and viral testing to guide antibiotic use for respiratory infections in hospitalized adults: a randomized controlled trial**. *J Infect Dis.* 2015;212(11):1692-1700.
- May LS, Rothman RE, Miller LG, et al. **A randomized clinical trial comparing use of rapid molecular testing for Staphylococcus aureus for patients with cutaneous abscesses in the emergency department with standard of care**. *Infect Control Hosp Epidemiol.* 2015;36(12):1423-1430.
- Olans RN, Olans RD, and DeMaria A Jr. **The critical role of the staff nurse in antimicrobial stewardship – Unrecognized, but Already There**. *Clin Infect Dis.* 2016;62(1):84-89.
- 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.
- 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.

Core Element 5: Tracking and Monitoring Antibiotic Prescribing, Use, and Resistance

Monitoring antibiotic prescribing and resistance patterns is critical to identify opportunities for improvement and to assess the impact of improvement efforts.

- Systematic collection of antibiotic use and resistance data allows facilities to assess, monitor, and improve prescribing practices.

Examples of Implementation

Basic:

Process Measures

- Adherence to documentation policies, e.g., requirement to document indications for antibiotic use and requirements to document performance of time-outs.
- Tracking of diagnosis, drug, dose, duration, and de-escalation with antibiotic time-out.
- Adherence to facility-specific treatment recommendations or guidelines.
- Adherence to specified interventions.
- Accurate antibiotic allergy and adverse reaction histories.

Intermediate:

Outcome Measures

- Sequential tracking of antibiotic resistance patterns (e.g., gram negative resistance).
- Tracking of *C. difficile* infection rates.
- 30-day readmission rates for pneumonia and *C. difficile*.

Advanced:

Antibiotic Use Measures

- Number of antibiotics administered to patients per day (i.e., days of therapy, or “DOT”). Hospitals can use the CDC National Healthcare Safety Network (NHSN) Antibiotic Use Option to

track and benchmark days of therapy.

- Grams of antibiotics used (defined daily dose, or “DDD”) could be used if DOT not available.
- Standardized antibiotic administration ratio (SAAR), an NQF-endorsed quality benchmarking measure for antibiotic use, available to hospitals enrolled in the NHSN Antibiotic Use Option.
- Direct antibiotic expenditures (purchasing costs).

Potential Barriers Suggested Solutions

ASP Does Not Have Resources to Conduct Measurements

Suggested Solutions

- Review organisms on CDC threat report, identify top pathogens relevant to the institution, and monitor one or more of those.
- Standardize data collection in terms of information, recording practices, and timing/frequency.
- Consider choosing one measure of antibiotic use.

- Partner with quality improvement and infection control staff to explore and identify ways to partner for data collection.

Lack of Expertise for Data Collection, Analysis, and Interpretation

Suggested Solutions

- Consider using audit tools or point prevalence surveys to help assess appropriate use (e.g., for urinary tract infections, community acquired pneumonia, and vancomycin).

- Use shared data to compare with other hospitals.
- Develop relationships with data experts through state collaboratives, health departments, specialty societies, or trade associations.

Lack of Enough Isolates to Produce an Antibiogram

Suggested Solution

- Review antibiotic susceptibility data on a regional basis.

Overwhelming Amount of Antibiotic Use and Resistance Data

Suggested Solution

- Engage units in tracking efforts (e.g., ask every unit to track and report on one syndrome and identified metrics).

Suggested Tools and Resources

Appropriate Antibiotic Use

- Centers for Disease Control and Prevention (CDC). Implementation Resources. [Assessment tools for antibiotic use](#).
- Septimus E. [Antimicrobial stewardship—qualitative and quantitative outcomes: the role of measurement](#). *Curr Infect Dis Rep*. 2014;16(11):433.
- Ibrahim OM, Polk RE. [Benchmarking antimicrobial drug use in hospitals](#). *Expert Rev Anti Infect Ther*. 2012;10(4):445–457.
- National Quality Forum (NQF). Quality Positioning System. NQF-endorsed [Standardized Antibiotic Administration Ratio](#)
- CMS. gov. Physician Quality Reporting System. [Measure #407: Appropriate treatment of methicillin-sensitive staphylococcus aureus \(MSSA\) bacteremia – National Quality Strategy domain: effective clinical care](#).

Modules, Exercises, and Infographics

- Centers for Disease Control and Prevention (CDC). [Antimicrobial Use and Resistance \(AUR\) Module](#). Atlanta, GA: CDC: 2016.

Lack of IT Infrastructure

Suggested Solution

- Ensure that tracking and monitoring are part of discussions with IT staff and facility administration when engaging their support for stewardship efforts.

Challenges in Defining “Appropriate” or “Optimal”

Suggested Solutions

- Use facility-specific guidelines as the basis for decisions about appropriate use; disregard complex cases that cannot be assessed easily.
- Conduct occasional (e.g., quarterly) structured audits of appropriate use to identify targets for improvement.
- Use standardized audit tools for appropriate use.

- Centers for Disease Control and Prevention (CDC); National Healthcare Safety network (NHSN). [Antibiogram demo exercise: advanced line list; Demo exercise results: advanced line list](#). Atlanta, GA: CDC; 2014.

- Centers for Disease Control and Prevention (CDC). [Antibiotic Resistance Solutions Initiative Infographic](#). Atlanta, GA: CDC; 2015.

- Centers for Disease Control and Prevention (CDC). [Multidrug-Resistant Organism & Clostridium difficile Infection module](#). Atlanta, GA: CDC; 2016.

Clinical and Laboratory Standards Institute

- Clinical and Laboratory Standards Institute. M39-A4 QG. [Antibiograms: developing cumulative reports for your clinicians quick guide](#).

Additional Resources

- Premier Safety Institute. [Antimicrobial stewardship: Combating antibiotic resistance website](#).
- Premier Safety Institute. [Quest Antimicrobial Collaborative website](#).

Core Element 6: Reporting Information on Improving Antibiotic Use and Resistance

Regular reporting of information on antibiotic use and resistance to physicians, nurses, and relevant staff serves as a key element of a successful antibiotic stewardship program.

- The antibiotic stewardship program (ASP) team regularly shares facility-specific antibiotic use and outcomes results with all healthcare providers, hospital leadership, and other key stakeholders (e.g., infection prevention and quality improvement committees).

Examples of Implementation

Basic

- Prepare regular reports on the measures being tracked related to antibiotic use.
- Include ASP report as a standing report to key stakeholders within the facility, e.g., pharmacy and therapeutics, patient safety/quality, medical staff committees, and the hospital board.
- Report to medical staff committee and health system board.
- Hold quarterly staff meetings with physicians, with a permanent place on the agenda to share ASP data.
- Post data on physician shared webpage and distribute through emails.
- Ensure ASP reports are available to leadership, staff, and patients.
- Prepare unit-specific reports

to disseminate to individual hospital locations.

- Consider reports that might be relevant to specific provider groups (e.g., surgical prophylaxis data for surgeons, treatment of community acquired pneumonia, and urinary tract infections and skin infections for hospitalists).
- Report data to the C-suite at regular intervals, along with actionable items.

Intermediate

- Include updates on progress towards meeting all hospital goals for antibiotic stewardship and recommendations for future improvement in reports.
- Reports should include information on overall antibiotic use and trends, interventions accepted and actions taken, and measures of appropriate use and outcome measures such as *C. difficile* infection rates and resistance.

- Include concrete recommendations for improvement in reports.
- Encourage early adoption of reporting into NHSN AU Module to receive SAAR reports.
- Include antibiotic susceptibility and use topics in newsletters.
- Present “what we are doing and why we need stewardship” to the governing board.
- Post unit-specific data in visible places to engage unit staff in stewardship.

Advanced

- Distribute provider-level information on antibiotic use and suggestions for improvement at the prescriber level, if possible.
- Implement a real-time facility-specific dashboard for ASP metrics available for all staff to view.

Potential Barriers and Suggested Solutions

Lack of Trust of Data and Results

Suggested Solutions

- Ensure that the people interpreting data and preparing reports have appropriate expertise, and use risk adjustment if available.
- Highlight results of successful improvement strategies.
- Have peers share the reports with specific departments (e.g., hospitalists with the hospitalist group).

Lack of Consistent Reporting

Suggested Solution

- Establish clear expectations for frequency of reporting.

Reporting Perceived as Punitive

Suggested Solutions

- Use measures and stories that resonate with clinicians and patients.
- Focus reports to providers on actionable information (e.g., compliance with treatment recommendations and performance of time-outs).
- Frame reports with language that is

nonthreatening and that emphasizes opportunities for learning and mentoring.

Timeliness of Reports and Antibigram

Suggested Solution

- Tie reporting to syndrome-specific reports (e.g., provide community-acquired pneumonia in winter).

Lack of Expertise in Analyzing Data and Developing Good Reporting Structure

Suggested Solution

- Seek expertise from other groups with experience in generating hospital quality data reports (e.g., quality/patient safety department, infection control, health departments, and regional quality improvement collaboratives).

Overwhelming Volume of Data

Suggested Solutions

- Target only top infection priorities for the institution at first and expand to other initiatives later.
- Identify three metrics that can be understood easily by your team and hospital.
- Focus on one or two outcomes at a time.

Suggested Tools and Resources

Data Reporting

- Centers for Disease Control (CDC). Implementation resources. [Assessment tools for antibiotic use](#).

- Septimus E. [Antimicrobial stewardship—qualitative and quantitative outcomes: The Role of Measurement](#). *Curr Infect Dis Rep*. 2014;16(11):433.

Core Element 7: Education of Clinicians and Patients and Families

Education about causes and trends of antibiotic resistance and guidance on approaches to promote optimal prescribing are key to an effective antibiotic stewardship program. Regardless of discipline, ongoing training opportunities should be available to physicians, pharmacists, and nurses. Hospitals and medical staff should also engage and provide education to patients and families.

- Education is provided on a regular basis to all staff as well as patients and families; education is targeted where appropriate.

Examples of Implementation

Basic

- Integrate regular (e.g., monthly or at least quarterly) updates on antibiotic stewardship and resistance into communications tools (e.g., blogs, website, intranet, and employee newsletters).
- Highlight system goals for antibiotic stewardship in educational programs and materials.
- Integrate patient stories and/or narratives from doctors who altered prescribing habits after a patient suffered an adverse event.

Intermediate

- Present antibiotic use and resistance data in grand rounds.
- Provide targeted in-person

or web-based educational presentations and messages to key provider groups at least annually (e.g., staff meetings for sections, and surgical morbidity and mortality conferences).

- Develop clear, concise educational messages that include concrete suggestions for actions to improve use.
- Educate prescribers on antibiotic resistance data and interpretation of micro data.
- Establish a collaborative that has coaching goals for hospitals and expert webinar presentations.

Advanced

- Participate in national stewardship efforts to raise awareness with employees and patients.

- Focus educational content on quality and safety, rather than cost savings.
- Include information on antibiotic stewardship and resistance in required annual provider educational programs.
- Include information on antibiotics in patient education materials.
- Establish antibiotic stewardship curriculum in medical education and training.
- Incorporate antibiotic stewardship elements into orientation for new medical staff.

Potential Barriers and Suggested Solutions

Education Prioritized Lower Because of Time Constraints

Suggested Solutions

- Train stewardship champions from multiple disciplines to lead formal and informal education activities.
- Require clinical education based on current knowledge and experience for all prescribers, with multiple offerings to fit different schedules.

Overwhelming Body of Educational Materials on AS

Suggested Solution

- Synthesize materials for staff (e.g., newsletters, posters, and memos); links to resources are overwhelming.

Data Not Well-Received, Poorly Engaged Audience

Suggested Solutions

- Consider using specific case studies to engage providers (e.g., review a case of *C. difficile* from last month).
- Add patient narratives to case review where possible.
- Engage patient advocates who have been directly affected by *C. difficile* antibiotic resistance, especially for forums like grand rounds.

Challenging to Measure Effectiveness to Justify Resources

Suggested Solution

- Measure response through post-tests or other knowledge assessment metrics and supply provider-specific feedback.

Suggested Tools and Resources

General Education

- Centers for Disease Control and Prevention (CDC). [Get smart about antibiotics week website](#).

Clinical Education

- Wake Forest School of Medicine. [Get smart about antibiotics: an antibiotic stewardship curriculum for medical students](#).

Patient Education

- Choosing Wisely. [Patient-friendly resources](#).
- Consumer Reports Health. [In depth: antibiotics](#).
- Choosing Wisely. [Antibiotics: Will They Help or Hurt You?](#) New York NY: Consumer Reports; 2015.
- Choosing Wisely. [Antibiotics: When you need them – and when you don't](#). New York, NY: Consumer Reports Health; 2014.

- Choosing Wisely. [Antibiotic treatment in the hospital: sometimes it can be stopped](#). New York, NY: Consumer Reports Health; 2016.
- The Joint Commission. [Speak up: antibiotics - know the facts](#) (available in English and Spanish; can be translated into other languages) website.

Patient Stories, Speakers, and Other Resources

- [Peggy Lillis Foundation](#) (*C. difficile* education and advocacy)
- [Patient Voice Institute](#)
- [Rory Staunton Foundation](#) (sepsis prevention)
- [Consumer Union Safe Patient Project](#)
- [Fecal Transplant Foundation](#)
- [Quinolone Vigilance Foundation](#)

MEASUREMENT APPROACHES

Performance measurement is an important aspect of any quality improvement program, and the above descriptions of Core Elements 5 and 6—Tracking and Reporting, respectively—address measurement. This section of the *Playbook* dives deeper into measurement approaches encouraged by stewardship experts. Currently, only one NQF-endorsed performance measure addresses specific aspects of stewardship; however, other measures may be helpful in addressing the *Core Elements*. Additionally, there is ongoing work to develop meaningful measures to assess and monitor antibiotic utilization, antibiotic resistance, patient outcomes, and the quality of stewardship programs.

NHSN Antimicrobial Use and Resistance Modules

Through the National Healthcare Safety Network (NHSN), healthcare facilities can now electronically monitor both antibiotic resistance and antibiotic prescribing data to improve physician, pharmacy, and laboratory decisionmaking. This data allows the CDC to provide benchmark antibiotic use and resistance data, which helps healthcare facilities monitor their ASP. Additional information can be found on the CDC website on [surveillance for antimicrobial use and antimicrobial resistance options](#).

NQF-Endorsed Measure #2720: NHSN Antimicrobial Utilization

Measure Steward: Centers for Disease Control and Prevention

NQF-endorsed measure #2720 was developed by the CDC and complements the CDC's Antimicrobial Use and Resistance Module. This measure permits hospital benchmarking of antibiotic use through the Standardized Antimicrobial Administration Ratio (SAAR). The SAAR is a risk-adjusted measure that compares observed antibiotic use to expected use for a

variety of agent groups and patient locations. The SAAR measure is currently endorsed for quality improvement purposes and is intended to help stewardship programs target their efforts.

Additional details on the [measure specifications](#) can be found on the NQF website.

Measure Description

NQF measure #2720 assesses antimicrobial use in hospitals based on medication administration data that hospitals collect electronically at the point of care and report via electronic file submissions to the CDC's National Healthcare Safety Network (NHSN). The antimicrobial use data that are in scope for this measure are antibacterial agents administered to adult and pediatric patients in a specified set of ward and intensive care unit locations: medical, medical/surgical, and surgical wards and units. The measure compares antimicrobial use that the hospitals report with antimicrobial use that is predicted on the basis of nationally aggregated data. The measure comprises a set of ratios, Standardized Antimicrobial Administration Ratios (SAARs), each of which summarizes observed-to-predicted antibacterial use for one of 16 antibacterial agent-patient care location combinations. The SAARs are designed to serve as high-value targets or high-level indicators for antimicrobial stewardship programs (ASPs). Outlier SAAR values are intended to prompt analysis of possible overuse, underuse, or inappropriate use of antimicrobials, and inform subsequent actions aimed at improving the quality of antimicrobial prescribing, and affect evaluations of ASP interventions.

Numerator Statement

Days of antimicrobial therapy for antibacterial agents administered to adult and pediatric patients in medical, medical/surgical, and surgical wards and medical, medical/surgical, and surgical intensive care units.

Denominator Statement

Days present for each patient care location is defined as the number of patients who were present for any portion of each day of a calendar month for each location. The days of admission, discharge, and transfer to and from locations are included in days present. All days present are summed for each location and month, and the aggregate sums for each location-month

combination comprise the denominator data for the measure.

Exclusions

Hospital patient care locations other than adult and pediatric medical, medical/surgical, and surgical wards and adult and pediatric medical, medical/surgical, and surgical intensive care units are excluded from this measure currently.

ESTABLISHING A MEASUREMENT FRAMEWORK FOR YOUR ANTIBIOTIC STEWARDSHIP PROGRAM

In addition to using an NQF-endorsed measure to assess the performance of your facility, use of a variety of measures might be beneficial to identify

problem areas, target interventions, and monitor improvement. Table 1 below identifies measures that stewardship programs have used.

TABLE 1. SUGGESTED MEASURES FOR ANTIBIOTIC STEWARDSHIP

Measurement Area	Measure
Antibiotic consumption	<ul style="list-style-type: none"> • Days of therapy (DOT) per 1,000 patient days—overall and for specific agents or groups of agents • Defined daily dose (DDD) per 1,000 patient days (if DOT not available) • Standardized Antibiotic Administration Ratio*
Process measures	<ul style="list-style-type: none"> • Provision of indication with each antibiotic start • Percentage of cases where therapy is appropriate (especially for serious infections, such as sepsis) • Appropriate Treatment of Methicillin-Sensitive Staphylococcus aureus (MSSA) Bacteremia • Frequency at which de-escalation occurs • Timely cessation of antibiotics given for surgical prophylaxis • Antibiotics not prescribed to treat asymptomatic bacteria • Appropriate cultures obtained before starting antibiotics • Adherence to hospital-specific guidelines • Acceptance of ASP recommendations • Frequency of performance of antibiotic time outs or reviews • Timely administration of appropriate antibiotics in cases of suspected sepsis

Measurement Area	Measure
Outcome measures	<ul style="list-style-type: none"> • Length of stay • Cure of infection • Risk-adjusted mortality • Hospital readmissions for select infections • Hospital-onset C. difficile infections* • Adverse drug reactions (number/percentage/rate) • Antimicrobial resistance- focusing on hospital onset cases would most likely best reflect the impact of ASPs • Provider-level measures if available (e.g., treatment of <i>S. aureus</i> and bloodstream infections)
Financial	<ul style="list-style-type: none"> • Antibiotic cost per patient day • Antibiotic cost per admission • Total hospital cost per admission

*NQF-endorsed measure

ADDITIONAL POTENTIAL STRATEGIES AND FUTURE DIRECTIONS

This section provides an overview of additional potential levers that could be used to improve antibiotic stewardship, including accreditation, public reporting, patient and provider engagement, health information technology, and quality improvement. NQP has worked with key stakeholders to include practical strategies in the *Playbook* for the implementation of antibiotic stewardship programs. Several timely additional potential strategies have emerged to help drive the momentum on antibiotic stewardship.

Accreditation, Public Reporting, and Payment

In order for antibiotic stewardship programs to achieve sustainability and succeed, they will need leadership and funding support. Regulatory and accreditation standards can help ensure that support. Similarly, public reporting requirements and/or links to payment can help spur antibiotic stewardship efforts. In November 2015, The Joint Commission proposed a new standard for

antimicrobial stewardship for general hospitals and critical-access hospitals. The proposed standard (MM.09.01.01) aims to determine whether facilities have an antimicrobial stewardship program that meets the eight requirements (elements of performance) within the standard. The standard underwent review in late 2015, and comments indicated that the standard was supported by scientific evidence and would improve patient safety.

The Leapfrog Group has added a new **subsection on antibiotic stewardship programs** to its 2016 Hospital Survey. In order to support national efforts regarding the responsible use of antibiotics in hospitals, Leapfrog will publicly report hospital compliance with the CDC's *Core Elements*. To collect information on hospital adoption of the seven *Core Elements*, Leapfrog will use 12 questions from the CDC's National Healthcare Safety Network (NHSN) Annual Hospital Survey on antibiotic stewardship programs (questions #23-34 from the NHSN Annual Hospital Survey).

The health insurer, Anthem, has implemented a Quality-In-Sights Hospital Incentive Program (Q-HIP), a national hospital quality- and value-based payment initiative that rewards hospitals for meeting quality, patient safety, outcomes, and patient satisfaction measures. The Q-HIP measure selection process focuses on national healthcare priorities. The program researches efforts by nationally recognized quality organizations for potential measure criteria and implementation tools for hospitals. A draft measure is then developed for feedback from National Advisory Panel and Q-HIP hospitals, and new measures are introduced into the program. Anthem has developed a measure to assess implementation of the CDC *Core Elements* in participating facilities.

In 2008, the Centers for Medicare & Medicaid Services (CMS) implemented **nonpayment for treatment of some hospital-acquired infections** and found that the Medicare policy was associated with a decline in the rate of hospital-acquired vascular catheter-associated infections and catheter-associated urinary tract infections. CMS also has the Surveyor Hospital Patient Safety Initiative (PSI) **Hospital Infection Control Worksheet**, a risk evaluation tool.

In addition, CMS is inviting the public to **comment on a proposed rule** to include hospitals' antibiotic prescribing data to the CMS Hospital Inpatient Quality Reporting (IQR) Program. Hospitals would send their information to CMS through CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use module. Hospitals would then be able to compare their antibiotic prescribing to national benchmarks and evaluate and improve antimicrobial prescribing as needed.

CMS has also included electronic reporting of antimicrobial use (AU) and antimicrobial resistance (AR) data to CDC's National Healthcare Safety Network (NHSN) Antibiotic Use and Resistance (AUR) module as part of **Meaningful Use** Stage 3, which would provide an incentive for hospitals and vendors.

Patient and Provider Education and Engagement

Consumer engagement and patient education play an important role in achieving appropriate antibiotic use. Including the patient perspective in antibiotic stewardship programs and educating patients and caregivers will enable patients to be effective partners in stewardship efforts and improve health literacy. For example, resources in provider practice settings to educate patients to ask questions about antibiotic prescribing are helpful.

Choosing Wisely, an initiative of the American Board of Internal Medicine (ABIM) Foundation, helps physicians and patients engage in conversations about the overuse of tests and procedures and supports physician efforts to help patients make smart and effective care choices. Several **recommendations**, such as those from The Society for Healthcare Epidemiology of America, address antibiotic stewardship. ABIM has partnered with Consumer Reports to create **patient-friendly materials** on antibiotic stewardship that translate the recommendations into plain language for consumers. Organizations could also consider working with websites that have patient resources, such as WebMD and Medscape, to provide information on antibiotic prescribing and adverse effects.

Providers of continuing medical education can increase the availability of programs focused on antibiotic stewardship for physicians, nurses, pharmacists, and facility leadership and also include non-physician prescribers as an audience. Medical and pharmacy schools can incorporate antibiotic stewardship into their curricula throughout postgraduate training to begin preparing and engaging tomorrow's leaders. ASP training should include infectious diseases fellows and pharmacy residents. Increased funding for specialty training would assist these efforts.

Health Information Technology

Hospital information technology systems are incorporating more features that will help with antibiotic stewardship. For example, some electronic health record (EHR) systems now include the capability to report data directly through the CDC's National Healthcare Safety Network (NHSN) Antibiotic Use option. In the future, health IT companies could work to include more surveillance and decision support features to help optimize antibiotic prescribing.

Quality Improvement

Specialty societies and trade associations should continue to develop certification programs in antibiotic stewardship and offer affordable access to content as member benefits, particularly to smaller facilities. In addition, these organizations can provide subject matter experts to serve as a resource on a rotational basis, particularly infectious diseases physicians and pharmacists. Hospitals can also form regional collaboratives to provide guidance, education, and clinical support. Patient organizations can engage groups in quality improvement efforts for ASP. Federal agencies, including the Agency for Healthcare Research and Quality, the Centers for Disease Control and Prevention, and the National Institutes of Health, can conduct further research to build evidence to support stewardship programs and interventions, and to develop improved methods for conducting stewardship and for promoting the implementation of stewardship programs.

Looking to the Future

Investment in antibiotic stewardship programs has been demonstrated to improve patient outcomes, reduce antibiotic resistance, and save lives as well as reduce healthcare costs. This *Playbook* seeks to provide a range of practical strategies to guide implementation of antibiotic stewardship programs. However, many additional areas remain for future consideration. State and local health departments could serve as a valuable resource to support antibiotic stewardship efforts. Public health can coordinate stewardship across the continuum of care in communities or regions.¹⁶

While the *Playbook* has recommended investment in salary support for antibiotic stewardship program leaders, guidelines on specifics need to come from experts. Provider-level quality measures as well as a comprehensive understanding of situations where antibiotics are commonly misprescribed can support ASP efforts. Further, antibiotic drug discovery and development, rapid diagnostics, and surveillance are very significant issues for further work.

As the focus of the *Playbook* is on acute care, it does not address guidance for antibiotic stewardship in other settings. Improved antibiotic use and efforts like the ones outlined in the *Playbook* are also needed in outpatient and long-term care settings. A comprehensive, long-range strategy for antibiotic stewardship should extend beyond the acute-care hospital setting to the full continuum of care.

ENDNOTES

- 1 Centers for Disease Control and Prevention (CDC). Get smart for healthcare website. <http://www.cdc.gov/getsmart/healthcare/>. Last accessed April 2016.
- 2 CDC. *Get Smart for Healthcare. Know When Antibiotics Work. Introductory slide set*. Atlanta, GA: CDC; 2015. Available at <http://www.cdc.gov/getsmart/healthcare/pdfs/getsmart-healthcare.pdf>. Last accessed April 2016.
- 3 CDC. *Antibiotic Resistance Threats in the United States*. Atlanta, GA: 2013. Available at <http://www.cdc.gov/drugresistance/threat-report-2013/>. Last accessed April 2016.
- 4 IMS Health. *Avoidable Costs in U.S. Healthcare*. Danbury, CT: IMS Health; 2013.
- 5 Executive Order No. 13676. Combating Antibiotic-Resistant Bacteria. *Fed Regist*. 2014; 184(79):56931-56935.
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APPENDIX: URL LINKS TO RESOURCES

Core Element 1: Leadership Commitment

Link Description	Address
Antimicrobial Management Program Gap Analysis Checklist	http://www.cdc.gov/getsmart/healthcare/improve-efforts/resources/pdf/AMP-GapAnalysisChecklist.pdf
Current Evidence on Hospital Antimicrobial Stewardship Objectives	http://dx.doi.org/10.1016/S1473-3099(16)00065-7
Greater New York Hospital Association/United Hospital Fund Antimicrobial Stewardship Toolkit	http://www.shea-online.org/Portals/0/GNYHA_Antimicrobial_Stewardship_Toolkit_FINALv2 Dec2011.pdf
Anthem Quality-In-Sights®: Hospital Incentive Program (Q-HIP)	https://www.anthem.com/provider/noapplication/f0/s0/t0/pw_b154968.pdf?refer=ahpprovider&state=nh
Making the Business Case for ASP	http://www.shea-online.org/Portals/0/PDFs/Business_Case_for_ASP.pdf
CDC Get Smart About Antibiotics: Save Money With Antibiotic Stewardship Fact Sheet	http://www.cdc.gov/getsmart/week/downloads/gsw-factsheet-cost.pdf
Antimicrobial Stewardship – A Value-Driven Means to Improved Patient Outcomes and Reduce Costs	https://www.hfma.org/Content.aspx?id=46774
A virtual ID Specialist: Antimicrobial stewardship via telemedicine	http://www.beckershospitalreview.com/healthcare-information-technology/a-virtual-id-specialist-antimicrobial-stewardship-via-telemedicine.html
<i>CDC Core Elements of Hospital Antibiotic Stewardship Programs</i>	http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf
National Strategy for Combating Antibiotic-Resistant Bacteria	https://www.whitehouse.gov/sites/default/files/docs/carb_national_strategy.pdf
National Action Plan for Combating Antibiotic-Resistant Bacteria	https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibiotic-resistant_bacteria.pdf
CDC Get Smart for Healthcare: Overview and Evidence to Support Stewardship	http://www.cdc.gov/getsmart/healthcare/evidence.html
New Societal Approaches to Empowering Antibiotic Stewardship: <i>JAMA</i>	http://dx.doi.org/doi:10.1001/jama.2016.1346
American Hospital Association Appropriate Use of Medical Resources Antimicrobial Stewardship Toolkit	http://www.ahaphysicianforum.org/resources/appropriate-use/antimicrobial/ASP-Toolkit-v3.pdf
The Society for Healthcare Epidemiology of America Implementation Tools and Resources	http://www.shea-online.org/PriorityTopics/AntimicrobialStewardship/ImplementationToolsResources.aspx
Joint Commission Resources	http://www.jcrinc.com/

Core Element 2: Accountability

Link Description	Address
Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America.	http://dx.doi.org/10.1093/cid/ciw118
The Infectious Diseases Society of America Practice Guidelines	http://www.idsociety.org/IDSA_Practice_Guidelines/
The Society for Healthcare Epidemiology of America Guidelines and Expert Guidance Documents	http://www.shea-online.org/GuidelinesResources/Guidelines.aspx
Policy Statement on Antimicrobial Stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS)	http://www.jstor.org/stable/10.1086/665010
The Society for Healthcare Epidemiology of America website	http://www.shea-online.org/
The Infectious Diseases Society of America	http://www.idsociety.org/
Pediatric Infectious Diseases Society	https://www.pids.org/
MAD-ID Antimicrobial Stewardship Training Programs	http://mad-id.org/antimicrobial-stewardship-programs/
Annual International Pediatric Antimicrobial Stewardship Conference Website	http://www.pids.org/meetings-and-events/asp-conference.html
The Society for Healthcare Epidemiology of America Training Course	http://www.shea-online.org/Education.aspx
IDWeek Premeeting Workshops	http://www.idweek.org/premeeting-workshop/
Society of Infectious Diseases Pharmacists Antimicrobial Stewardship Certificate Program	http://www.sidp.org/page-1442823
Stanford Medicine Online Continuing Medical Education Course: Antimicrobial Stewardship: Optimization of Antibiotic Practices	https://med.stanford.edu/cme/courses/online/antimicrobial.html
Telemedicine-Based Antimicrobial Stewardship Program Improves Prescribing, Reduces Bacterial Resistance to Antibiotics at Rural Hospital	https://innovations.ahrq.gov/profiles/telemedicine-based-antimicrobial-stewardship-program-improves-prescribing-reduces-bacterial
Colorado Hospital Association: Antimicrobial Stewardship Commitment Letter	http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=82401
Engaging Hospitalists in Antimicrobial Stewardship: Lessons From a Multihospital Collaborative	http://dx.doi.org/10.1002/jhm.2599
Guidance for the Knowledge and Skills Required for Antimicrobial Stewardship Leaders	http://www.jstor.org/stable/10.1086/678592
The Advisory Board: Findings from our antibiotic stewardship program survey	https://www.advisory.com/technology/crimson-continuum-of-care/members/expert-insights/the-current-state-of-hospital-antibiotic-stewardship

Core Element 3: Drug Expertise

Link Description	Address
Guidance for the Knowledge and Skills Required for Antimicrobial Stewardship Leaders	http://www.jstor.org/stable/10.1086/678592
American Society of Health-System Pharmacists Statement on the Pharmacist's Role in Antimicrobial Stewardship and Infection Prevention and Control	http://www.ashp.org/DocLibrary/BestPractices/SpecificStAntimicrob.aspx
American Society of Health-System Pharmacists Antimicrobial Stewardship Resources	http://www.ashp.org/menu/PracticePolicy/ResourceCenters/Inpatient-Care-Practitioners/Antimicrobial-Stewardship
The essential role of pharmacists in antimicrobial stewardship.	http://dx.doi.org/10.1017/ice.2016.82
Society for Infectious Diseases Pharmacists website	http://www.sidp.org/
Software vendors who support the CDC antimicrobial use and resistance initiative	http://www.sidp.org/aurvendors
The Sanford Guide to Antimicrobial Therapy 2016	http://www.sanfordguide.com
MAD-ID Antimicrobial Stewardship Programs	http://mad-id.org/antimicrobial-stewardship-programs/
Annual International Pediatric Antimicrobial Stewardship Conference website	http://www.pids.org/meetings-and-events/asp-conference.html
The Society for Healthcare Epidemiology of America Antimicrobial Stewardship Training Course	http://www.shea-online.org/Education.aspx
IDWeek Premeeting Workshops	http://www.idweek.org/premeeting-workshop/#stewardship
Society of Infectious Disease Pharmacists (SIDP) Antimicrobial Stewardship Certificate Program	http://www.sidp.org/page-1442823
Stanford Medicine Online Continuing Medical Education Course: Antimicrobial Stewardship: Optimization of Antibiotic Practices	https://med.stanford.edu/cme/courses/online/antimicrobial.html
Telemedicine-Based Antimicrobial Stewardship Program Improves Prescribing, Reduces Bacterial Resistance to Antibiotics at Rural Hospital	https://innovations.ahrq.gov/profiles/telemedicine-based-antimicrobial-stewardship-program-improves-prescribing-reduces-bacterial

Core Element 4: Actions

Link Description	Address
Antibiotic Self-Stewardship: Trainee-Led Structured Antibiotic Time-outs to Improve Antimicrobial Use	http://dx.doi.org/10.7326/M13-3016
Southwest Memorial Hospital Stewardship Committee: ASP Documentation	http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=82402
Software Vendors who Support the CDC Antimicrobial Use and Resistance Initiative	http://www.sidp.org/aurvendors
AHRQ Toolkit for Reduction of <i>Clostridium difficile</i> Infections Through Antimicrobial Stewardship	http://www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/cdiff toolkit/index.html

Link Description	Address
Clinical Practice Guidelines by the Infectious Diseases Society of America for the Treatment of Methicillin-Resistant <i>Staphylococcus Aureus</i> Infections in Adults and Children	http://dx.doi.org/10.1093/cid/ciq146
Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America	http://cid.oxfordjournals.org/content/62/4/e1
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	http://dx.doi.org/10.1086/649554
Surviving Sepsis Campaign Guidelines	http://www.survivingsepsis.org/guidelines/Pages/default.aspx
Clinician Guide for Collecting Cultures	http://www.cdc.gov/getsmart/healthcare/implementation/clinicianguide.html
<i>The Sanford Guide to Antimicrobial Therapy 2016</i>	http://www.sanfordguide.com
Seven Ways to Preserve the Miracle of Antibiotics	http://dx.doi.org/10.1093/cid/cit070
Serum Procalcitonin Measurement and Viral Testing to Guide Antibiotic Use for Respiratory Infections in Hospitalized Adults	http://dx.doi.org/10.1093/infdis/jiv252
A Randomized Clinical Trial Comparing Use of Rapid Molecular Testing for <i>Staphylococcus aureus</i> for Patients With Cutaneous Abscesses in the Emergency Department With Standard of Care	http://dx.doi.org/10.1017/ice.2015.202
The Critical Role of the Staff Nurse in Antimicrobial Stewardship	http://dx.doi.org/10.1093/cid/civ697

Core Element 5: Tracking

Link Description	Address
CDC Assessment Tools for Antibiotic Use	http://www.cdc.gov/getsmart/healthcare/implementation.html
Antimicrobial Stewardship—Qualitative and Quantitative Outcomes: The Role of Measurement	http://dx.doi.org/10.1007/s11908-014-0433-x
Benchmarking antimicrobial drug use in hospitals	http://dx.doi.org/10.1586/eri.12.18
Standardized Antibiotic Administration Ratio	http://www.qualityforum.org/QPS/2720
2016 PQRS Measure #407: Appropriate Treatment of Methicillin-Sensitive Staphylococcus Aureus (MSSA) Bacteremia	https://pqrs.cms.gov/dataset/2016-PQRS-Measure-407-11-17-2015/m66s-yxfb
CDC Antimicrobial Use and Resistance (AUR) Module	http://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf
Antibiogram Demo Exercise: Advanced Line List	http://www.cdc.gov/nhsn/PDFs/demo/2-AdvancedLineList.pdf
Antibiogram Demo Exercise Results: Advanced Line List	http://www.cdc.gov/nhsn/PDFs/demo/2-AdvancedLineList-Solution.pdf

Link Description	Address
Antibiotic Resistance Solutions Initiative Infographic	http://www.cdc.gov/drugresistance/pdf/ar-nhsn.pdf
CDC and Prevention National Healthcare Safety Network Multidrug-Resistant Organism & <i>Clostridium difficile</i> Infection (MDRO/CDI) Module	http://www.cdc.gov/nhsn/PDFs/pscManual/12pscMDRO_CDADcurrent.pdf
Antibiograms: Developing Cumulative Reports for Your Clinicians Quick Guide (M39-A4 QG)	http://shop.clsi.org/microbiology-companion-products/M39-A4_3.html
Premier Safety Institute. Antimicrobial Stewardship: Combating Antibiotic Resistance	http://www.premierinc.com/antibiotics
Premier Safety Institute. Quest Antimicrobial Collaborative	http://www.premiersafetyinstitute.org/safety-topics-az/antimicrobial-stewardship/quest-antimicrobial-collaborative/

Core Element 6: Reporting

Link Description	Address
CDC Assessment Tools for Antibiotic Use	http://www.cdc.gov/getsmart/healthcare/implementation.html
Antimicrobial Stewardship—Qualitative and Quantitative Outcomes: The Role of Measurement	http://dx.doi.org/10.1007/s11908-014-0433-x

Core Element 7: Education

Link Description	Address
CDC Get Smart About Antibiotics Week	http://www.cdc.gov/getsmart/week/
Antibiotic Stewardship Curriculum for Medical Students	http://www.wakehealth.edu/AS-Curriculum/
Consumer Reports/Choosing Wisely Patient-Friendly Resources	http://www.choosingwisely.org/patient-resources/
Consumer Reports/Choosing Wisely: In Depth: Antibiotics	http://consumerhealthchoices.org/depth-antibiotics/
Consumer Reports/Choosing Wisely: Antibiotics: Will They Help or Hurt You?	http://consumerhealthchoices.org/wp-content/uploads/2015/02/3AntibioticsTri-Fold_DownloadGenericFINAL.pdf
Consumer Reports/Choosing Wisely: Antibiotics: When you need them - and when you don't	http://consumerhealthchoices.org/wp-content/uploads/2014/02/ChoosingWiselyAntibioticsRoundup.pdf
Consumer Reports/Choosing Wisely: Antibiotic treatment in the Hospital	http://consumerhealthchoices.org/wp-content/uploads/2016/02/ChoosingWiselyAntibioticsHospitalSHEA-ER.pdf
The Joint Commission: Speak Up: Antibiotics - Know the Facts	http://www.jointcommission.org/topics/speakup_antibiotics.aspx
Peggy Lillis Foundation	http://peggyfoundation.org/
Patient Voice Institute	http://gopvi.org/
Rory Staunton Foundation	https://rorystauntonfoundationforsepsis.org/
Consumer Union Safe Patient Project	http://safepatientproject.org/

Link Description	Address
Fecal Transplant Foundation	http://thefecaltransplantfoundation.org/
Quinolone Vigilance Foundation	http://www.saferpills.org/

Additional Resources

Link Description	Address
CDC Core Elements of Hospital Antibiotic Stewardship Programs	http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf
Surveillance for Antimicrobial Use and Antimicrobial Resistance Options	http://www.cdc.gov/nhsn/acute-care-hospital/aur/
National Healthcare Safety Network (NHSN) Antimicrobial Use Measure specifications	http://www.qualityforum.org/QPS/2720
Standardized Antibiotic Administration Ratio	http://www.qualityforum.org/QPS/2720
Appropriate Treatment of Methicillin-Sensitive Staphylococcus aureus (MSSA) Bacteremia (PQRS Measure #407)	https://pqrs.cms.gov/dataset/2016-PQRS-Measure-407-11-17-2015/m66s-yxfb
Hospital-Onset <i>C. difficile</i> Infections	http://www.qualityforum.org/QPS/1717
The Leapfrog Group website	http://www.leapfroggroup.org/ratings-reports/new-2016
National Healthcare Safety Network: Patient Safety Component—Annual Hospital Survey	http://www.cdc.gov/nhsn/forms/57.103_pshospssurv_blank.pdf
Medicare Non-Payment of Hospital-Acquired Infections	https://www.cms.gov/mmrr/Downloads/MMRR2013_003_03_a08.pdf
Centers for Medicare & Medicaid Services Hospital Infection Control Worksheet	https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-15-12-Attachment-1.pdf
Centers for Medicare & Medicaid Services Proposed Rule on Antibiotic Prescribing	https://federalregister.gov/a/2016-09120
CDC: Meaningful Use	http://www.cdc.gov/ehrmeaningfuluse/
Choosing Wisely: Antibiotic treatment in the hospital	http://consumerhealthchoices.org/wp-content/uploads/2016/02/ChoosingWiselyAntibioticsHospitalSHEA-ER.pdf
Consumer Reports/Choosing Wisely Campaign: In Depth: Antibiotics	http://consumerhealthchoices.org/depth-antibiotics/
Vital Signs: Estimated Effects of a Coordinated Approach for Action to Reduce Antibiotic-Resistant Infections in Health Care Facilities-United States	http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6430a4.htm

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