Actionable Patient Safety Solutions (APSS) #3B:

Antimicrobial stewardship

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for antimicrobial stewardship. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

Antimicrobial stewardship is efforts to promote the appropriate use of antimicrobials, including antibiotics, to prevent:

- Spread of infections
- Adverse reaction and adverse drug events
- Superinfections
- Infections that are resistant to antimicrobials
- Poor clinical outcomes

Create an action plan

- ☐ Assure commitment from institutional leadership (administration, medicine, pharmacy, nursing, microbiology, and technology) to create and support an Antimicrobial Stewardship Program (ASP)
- ☐ Create a multidisciplinary Antimicrobial Stewardship Committee that includes representatives from infectious diseases, pharmacy, infection prevention, information technology, microbiology, nursing, medicine, and surgery.
- ☐ Create ways to educate clinicians regarding ASP initiatives and progress
- ☐ Have a nurse or pharmacist review allergy history
- ☐ Have a pharmacist review all antimicrobial orders.

Engage staff and use data to find areas for improvement

- ☐ Identify and educate clinicians with outlying prescribing patterns
- ☐ Monitor progress and include the results in staff education
- ☐ Use Computerized Provider Order Entry (CPOE) with Clinical Decision Support (CDS) and computer-based surveillance software to provide real-time data at the point of care for ASP initiatives
- ☐ Review all antimicrobial orders by a hospital pharmacist, including a review of allergy profiles
- ☐ Use practices to reduce medication errors during Transitions of Care
- ☐ Use patient stories – in written and video form – to teach and inspire change in your staff

What we know about antimicrobial stewardship

Appropriate use of antimicrobials is a key part of patient safety. Inappropriate use of antimicrobials can have these unwanted effects:

- The pathogen (germ causing infection and disease) becomes resistant to antimicrobials and spreads within the healthcare system and into the community
- The patient may have adverse reactions, superinfections, selection of resistant pathogens, and poor clinical outcomes

Antimicrobials are the only medicationswhere use in one patient can affect how well that medication works in another patient. Contrary to common belief, antimicrobials are not harmless medications. In fact, studies have found antimicrobial use leads to poor outcomes, including:

- 21.6% of adverse drug events (AHRQ, 2018; Shehab et al., 2016)
- 19% of emergency department visits, with most from allergic reactions (2004-2006)
- 3 times higher risks for adverse events than for aspirin, phenytoin, and clopidogrel (Shehab, Patel, Srinivasan and Budnitz, 2008)
- *Clostridioides difficile (C. difficile)* colitis, an infection with a high risk of readmission and death

The appropriate use of antimicrobials helps create a safety culture, which is a culture that promotes patient safety and quality of care while reducing preventable risks and harm.

Practicing antimicrobial stewardship

A hospital can create an Antimicrobial Stewardship Program (ASP) committee to align with these standards and recommendations:

- In 2014, the Centers for Disease Control and Prevention (CDC) recommended that all acute care hospitals create Antibiotic Stewardship Programs
- In September 2014, California Governor Jerry Brown approved Senate Bill 1311 that requires all general acute care hospitals in California to create a physician supervised multidisciplinary Antimicrobial Stewardship committee by July 1, 2015 (California Legislative Information, 2014)
- In January 2017, the Joint Commission's new Medication Management Standard on Antimicrobial Stewardship requires hospitals and critical access hospitals to have an antimicrobial stewardship program in place
- The Centers for Medicare and Medicaid Services will require facilities participating in Medicare and Medicaid to have formal ASPs in place

A successful ASP committee includes the following members:

- Infectious diseases (ID)-trained physician
- Pharmacist, who is preferably ID-trained
- Infection control personnel
- Information technology personnel
- Quality improvement personnel
- Nursing
- Microbiology
- Committed leadership

The goals of the ASP committee are:

- Decrease inappropriate use of antimicrobials and optimize therapy

- Identify and reduce risks of developing, acquiring, and transmitting infections
- Reduce healthcare costs and toxicities with antimicrobials and inappropriate therapy
- Prevent adverse drug events related to antimicrobials
- Improve patient outcomes, such as reduced *C. difficile* rates and reduced hospital length of stay (LOS)

Leadership plan

Hospital governance, senior administrative leadership, clinical leadership, and safety/risk management leadership need to work collaboratively for antimicrobial stewardship.

Show leadership's commitment to antimicrobial stewardship

- Make formal statements from administrative level about:
  - Goals of the ASP
  - Support of the ASP
  - Best use of antimicrobials within the hospital
  - Progress of the ASP
- Show support from the senior administration
- Provide financial support

Create the infrastructure needed to make changes

- Create the needed system for tracking and measuring antimicrobial use and outcomes
- Follow CDC recommendations on core elements for hospital ASPs:
  - Commitment from institutional leadership (technology, personnel, finance)
  - Accountability of ASP chair or co-chairs
  - A clinician with drug expertise in antimicrobials (e.g., clinical pharmacist with ID training and/or expertise)
  - Actionable program components (e.g., prospective audit, automatic discontinuation orders)
  - Microbial resistance and infection patterns monitoring
  - Reports of and education about ASP findings to hospital staff (physicians, nurses, pharmacists, etc.)

Engage staff

- Protect and approve time for hospital personnel from various departments to take part in the ASP
- Train and support hospital personnel
- Use patient stories – in written and video form – to identify gaps and inspire change in your staff

Action plan

Create an Antimicrobial Stewardship Program (ASP)

- Create a multidisciplinary team that includes:

    - ID-trained physician
    - ID-trained or clinical pharmacist
    - Information technologists (CDC, 2015)
    - Nurse
- Choose the type of ASP based on your hospital size, type, and resources:
    - Restriction of antimicrobial utilization based on ASP
    - Prospective audit with feedback to ASP
    - A combination of both

This table shows the types of ASP committees and their pros and cons:

	Restrictive program ASP	**Prospective audit with feedback ASP**
What is it?	In this program, select antimicrobials are put on formulary restriction for use in only select indications. To dispense a restricted antimicrobial, designated personnel usually an ID physician, ID fellow, or clinical pharmacist would need to approve in order to be dispensed. Some institutions allow a 24 hour time frame for a restricted antimicrobial to be ordered and dispensed after which an ID consult is required to continue the restricted antimicrobial.	In this program, a prospective (hours to days) review of antimicrobial orders takes place for targeted, and in some institutions, non-targeted antimicrobials for appropriateness. If an opportunity is found, the prescriber is contacted and the case discussed. This also allows for feedback to the prescribers, which may affect their prescribing patterns in the future. It is also common to find programs that use a hybrid approach in which audit and feedback are employed along with a restricted formulary.
Pros	• Offers direct oversight in the use of restricted antimicrobials • Reduces pathogen resistance within the hospital and communities • Reduces hospital LOS • Reduces risks of antimicrobial-related side effects and drug-drug interactions	• Avoids loss of autonomy • Offers the chance to educate prescribers rather than restrict antimicrobial use. • Reduces pathogen resistance within the hospital and community • Many programs will review all antimicrobial antibiotic orders for appropriateness and therapy optimization

Cons	• Requires personnel to be available around-the-clock • Physicians may see this as a loss of autonomy Review of appropriateness only occurs with restricted agent, but not for unrestricted agents which can also lead to problems (Dellit, 2007; Goff et al., 2012) • Requires personnel dedicated to the ASP - most academic and medium- to-large community hospitals have personnel, but smaller hospitals may not have dedicated personnel available	• Compliance is often voluntary (Dellit, 2007) • Requires personnel dedicated to the ASP - most academic and medium- to-large community hospitals have personnel, but smaller hospitals may not have dedicated personnel available

Create pharmacy driven protocols

Pharmacy intervention	Rationale	Minimal resources required	Dedicated resources required
Protocols for changes from intravenous (IV) to oral (PO) antibiotic therapy in appropriate situations	• Decrease cost • Decrease hospital LOS • Reduce line infections	Pharmacist	Clinical stability criteria for IV to PO conversion: • Able to tolerate orals • Afebrile • Stable heart rate • Stable respiratory rate • Systolic blood pressure >90 mmHg • O2 saturation >90% (O2 partial pressure >60 mmHg) • Functional GI • Normal mental status • Lab results received identifying pathogen
Antimicrobial dosage adjustments in case of organ dysfunction	• Avoid toxicities	Pharmacist	
Dose optimization [pharmacokinetics (PK)/ pharmacodynamics (PD)] to treat pathogens with reduced susceptibility and sensitivity	• Avoid toxicities • Optimize PK/PD • Improve patient outcomes		
Automatic alerts where therapy might not be needed	• Avoid toxicities • Decrease costs	IT	
Time-sensitive automatic stop orders for specific antimicrobial prescriptions	• Decrease cost • Decrease unnecessary antimicrobial use • Decrease resistance	IT	

Start necessary treatment for patients who should be receiving antimicrobials	The delay of an active antimicrobial increases mortality		
Institution specific ASP guidelines	• Based on antimicrobial resistance patterns at your institution • Align with ASP initiatives • Provide a resource		
Implementation of extended infusion beta-lactams (e.g., piperacillin/ tazobactam)	• Maximizes the harmacodynamic parameter of time above the minimum inhibitory concentration (MIC) • May increase the development of resistance threshold • Has been shown to improve patient outcomes and potentially decreases costs		

Create microbiology lab protocols

Microbiology Protocol	Rationale	Minimal resources required	Dedicated resources required
Cumulative and location specific antibiogram creation (hospital-specific) once or twice a year, in accordance with the guidelines set forth in the Clinical and Laboratory Standards Institute (CLSI) document M39-A4.	Provides a mechanism for tracking microbial resistance and provides susceptibility data that can be utilized for empiric antimicrobial selection	Microbiology lab	
Regularly adopt CLSI antimicrobial breakpoint updates	Changes to CLSI breakpoints occur almost yearly, and often are due to new PK/PD considerations and/or patient clinical outcomes. Having the most up to date breakpoints used can potentially influence patient outcomes		
Rapid diagnostics, such as: • Nucleic Acid Amplification Test (NAAT) based platformsMultiplex PCR • Matrix Assisted Laser Desorption/ Ionization-Time Of Flight (MALDI-TOF)	• Decrease time to appropriate antibiotics and antifungals • Decrease unnecessary antimicrobial use		
Consider procalcitonin level measurement	• Tissues make procalcitonin during bacterial infection • Decrease unnecessary unneeded antibiotic antimicrobial use • Shortens length of therapy		

Automatic testing and reporting of tigecycline and colistin or newer agents if on hospital formulary (ceftazidime/ avibactam, meropenem/ vaborbactam, eravacycline) for Carbapenem Resistant Enterobacteriaceae (CRE) isolates	• Increase in carbapenem resistance		
Reporting of minocycline susceptibility for *Acinetobacter* isolates	• Minocycline susceptibility remains high in most institutions against multi-drug resistant *Acinetobacter spp*		
Cascade microbiology susceptibility reporting/susceptible dose dependent (SDD)	Cascade reporting is a process of withholding susceptibility results from selected categories of antimicrobials that may have negative effects on the hospital antibiogram/ resistance rates, or financial cost that do not have a therapeutic advantage over other commonly used antimicrobial agents. For example, if an E. coli strain is isolated from a bloodstream infection and is not susceptible to a first generation cephalosporin but is susceptible to cefotaxime, then other broad spectrum agents such as cefepime, meropenem, or ceftaroline could be withheld and made available.	Microbiology Lab	

Technology plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider:

https://patientsafetymovement.org/actionable-solutions/apss-workgroups/technology-vetting/

System or Practice	Available Technology	Evidence
ONC Meaningful Use Certified EHR system Electronic Health Record (EHR) System with the following capabilities: Computerized Provider Order Entry (CPOE) Drug-drug interaction check Drug-allergy interaction check Clinical Decision Support tools (CDS) tools		• Increases in patient safety • Cost savings • Decreases time on ASP activities (Kullar and Goff, 2014; Evans ***et al.***, 1998)
CPOE simulation tool to quantify the risk of serious ADEs with your current system CPOE		
Drug Libraries (Metzger *et al*., 2010; Leung *et al*., 2013)		
Pharmacy Workflow Manager		

Measuring outcomes

Key performance indicators

Any institution implementing an ASP must be able to measure 3 key variables:

- Antimicrobial use to assess whether interventions lead to changes in use
- Resistance patterns among microorganisms
- Outcomes associated with changes in antibiotic use

For example, metrics that are used to find the impact of the ASP:

- Defined daily doses (DDDs)
- Days of therapy (DOT) of antibiotics per 1000 patient days or
- Days of therapy (DOT) of antibiotics per 1000 patient days. Cost per quality adjusted life-year (QALY) could also be used to measure the cost-effectiveness of the program in preventing specific infections (e.g., bloodstream infections)
- *Clostrioides* difficile infection (CDI) - but just measuring CDI is not all encompassing (For a playbook to more comprehensively reduce CDI please see APSS #2C)

- Standardized Antimicrobial Administration Ratio (SAAR), which the CDC National Healthcare Safety Network (NHSN) provides to institutions that submit their antimicrobial use to NHSN. The standardized antimicrobial administration ratio (SAAR) compares observed to predicted days of antimicrobial therapy. It is calculated using indirect standardization where predicted antimicrobial use days are based on nationally aggregate antimicrobial use data.

Outcome measure formula

The calculation is: (DDDs / patient days) * 1000. Recent guidelines from the Infectious Disease Society of America, recommend the use of DOT per 1000 patient days over DDD, with DDD being an alternative at institutions that cannot collect DOT data.

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

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