Antibiotic Stewardship in Hospitals and Long-Term Care Facilities: Building an Effective Program

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ABSTRACT

Inappropriate antibiotic use, which includes prescribing drugs that are unnecessary, no longer necessary, or incorrectly dosed or using broad-spectrum agents when narrow-spectrum agents are appropriate for susceptible bacteria, is a national patient safety and public health concern. This practice perpetuates and exacerbates antibiotic resistance and contributes to conditions such as Clostridium difficile*–associated diarrhea, as well as adverse drug effects and increased morbidity and mortality. According to the Centers for Disease Control and Prevention, as much as 50% of all antibiotics prescribed in acute care hospitals in the United States are unnecessary or inappropriate. In long-term care facilities, 49% to 62% of prescriptions are estimated to meet appropriate diagnostic criteria. Control of multidrug-resistant organisms in healthcare facilities requires attention to judicious antibiotic use through adoption of an antibiotic stewardship program. Results of Pennsylvania Patient Safety Authority surveys of Pennsylvania acute care hospitals and long-term care facilities include opportunities for improvement in all facets of antibiotic stewardship and indicate facility interest in learning more about antibiotic stewardship and participating in a statewide or regional collaboration to support antibiotic stewardship programs. This article outlines strategies for identifying existing gaps in antibiotic stewardship programs and presents strategies for instituting or enhancing antibiotic stewardship programs in acute and long-term care facilities. (Pa Patient Saf Advis 2015 Jun;12[2]:71-8.)*

INTRODUCTION

Antibiotics have transformed the practice of medicine, combating life-threatening bacterial diseases, reducing morbidity, and saving lives.[1] However, inappropriate antibiotic use is a national patient safety and public health concern, as this practice perpetuates and exacerbates antibiotic resistance and contributes to conditions such as *Clostridium difficile*–associated diarrhea.[1] Inappropriate antibiotic use includes prescribing drugs that are unnecessary, no longer necessary, or incorrectly dosed, as well as using broad-spectrum agents when narrow-spectrum agents are appropriate for susceptible bacteria.[1]

A Centers for Disease Control and Prevention (CDC) 2014 *Vital Signs* report found that 20% to 50% of all antibiotics prescribed in acute care hospitals in the United States are unnecessary or inappropriate.[2] Poor communication when patients transfer facilities—for example, from a long-term care facility (LTCF) to a hospital—can result in antibiotic misuse.[3] Few studies have examined the percentage of inappropriate use of antibiotics in LTCFs; however, estimates of appropriate antibiotic use in LTCFs range from 49% to 62%.[4] For example, a 2001 study found that just 49% of prescriptions in LTCFs met appropriate diagnostic criteria.[5]

The Problem of Antibiotic Resistance

The ability of bacteria to resist the effects of antibiotics is perhaps the single most important infectious-disease threat.[4] Infections with resistant organisms are difficult to treat and require costly and potentially toxic alternatives. According to CDC, "Every year, more than two million people in the United States get infections that are resistant to antibiotics, and at least 23,000 people die as a result."[6] In addition, *C. difficile* infections, which can be very difficult to treat and also life-threatening, cause about 250,000 hospitalizations and at least 14,000 deaths annually in the United States.[4] Inappropriate antibiotic use can adversely affect the health of patients who are not even exposed to antibiotics due to the potential for the spread of resistant organisms.[1]

Frequent use of antibiotics in LTCF settings has led to resistant florae, and the proximity and contact between residents and healthcare workers facilitates the spread of these organisms.[7] In 2013, CDC highlighted the need to improve antibiotic use as one of four key strategies required to address the problem of antibiotic resistance in the United States.[8] Control of multidrug-resistant organisms in healthcare facilities requires attention to judicious antibiotic use through adoption of an antibiotic stewardship program.[1,9]

What Is Antibiotic Stewardship?

The Society for Healthcare Epidemiology of America defines antibiotic stewardship as "coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration."[10] Why implement an antibiotic stewardship program? Effective stewardship programs promote improved patient outcomes by doing the following:

- Reducing treatment failures, lengths of stay, morbidity, and mortality
- Increasing infection cures and the frequency of appropriate, cost-effective prescribing for therapy and prophylaxis

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Table. Antibiotic Stewardship Survey Results for Hospitals and Long-Term Care Facilities

	HOSPITALS (N = 12)				LONG-TERM CARE FACILITIES (N = 12)			
CDC DOMAIN AND CORE ELEMENTS*	YES	PLAN	NO	DON'T KNOW	YES	PLAN	NO	DON'T KNOW
LEADERSHIP DOMAIN								
Communicates formal statements supporting monitoring and improved use of antibiotics	9	2	1	0	5	0	7	0
Includes stewardship tasks in job descriptions and performance reviews	4	2	6	0	3	0	9	0
Supports training and education	9	1	2	0	8	0	4	0
ACCOUNTABILITY DOMAIN								
Identifies a physician leader for stewardship program activities and outcomes	12	0	0	0	8	0	4	0
EXPERTISE/SUPPORT DOMAIN								
Identifies a pharmacist to colead the program	12	0	0	0	5	0	7	0
Includes physician support	12	0	0	0	7	0	5	0
Includes nursing support	5	1	3	3	8	0	4	0
Includes department head support	3	0	5	4	3	0	9	0
Includes epidemiologist support	8	0	2	2	3	0	9	0
Includes staff support for quality assurance and performance improvement	6	0	3	3	5	0	7	0
Includes laboratory staff support	9	0	2	1	3	0	9	0
Includes information technology support	7	0	3	2	2	0	10	0
ACTION DOMAIN								
Developed and implemented policies and procedures to document dose, duration, and indication of antibiotics	6	2	4	0	5	1	5	1
Developed facility-specific treatment recommendations	10	0	2	0	4	0	7	1
Uses an antibiotic time-out after 48 hours	5	1	5	1	5	0	6	1
Developed site-specific treatment recommendations (e.g., for urinary tract infections)	8	0	3	1	4	0	7	1
Implements infection-specific interventions	9	0	2	1	4	0	7	1
Implements syndrome-specific interventions	5	1	5	1	2	0	9	1
Implements pharmacy-specific interventions	10	1	1	0	4	0	7	1
Implements preauthorization for specific antibiotics	7	0	5	0	1	0	10	1
Changes intravenous to oral antibiotic therapy automatically in appropriate situations	8	0	4	0	5	0	7	0
Implements dose adjustments in cases of organ dysfunction	10	0	1	1	5	0	7	0

Table. Antibiotic Stewardship Survey Results for Hospitals and Long-Term Care Facilities (continued)

	HOSPITALS (N = 12)				LONG-TERM CARE FACILITIES (N = 12)			
CDC DOMAIN AND CORE ELEMENTS*	YES	PLAN	NO	DON'T KNOW	YES	PLAN	NO	DON'T KNOW
ACTION DOMAIN (continued)								
Implements dose optimization for treatment of organisms with reduced susceptibility	11	0	1	0	4	0	5	3
Implements automatic alerts when therapy may be duplicative	9	0	2	1	4	0	7	1
Implements time-sensitive automatic-stop orders	5	1	4	2	4	0	6	2
TRACKING AND REPORTING DOMAIN								
Uses periodic assessment of appropriate antibiotic use (retrospective chart review)	11	0	0	1	8	0	4	0
Provides feedback to stewardship program members	9	2	0	1	8	0	4	0
Uses provider feedback	8	3	0	1	5	0	7	0
Documents program monitoring and feedback	8	2	0	2	4	1	6	1
Measures antibiotic use in days of therapy	4	2	5	1	4	0	7	1
Measures antibiotic use in defined daily dose	3	3	4	2	3	1	7	1
Tracks clinical outcomes to measure the impact of interventions	3	2	5	2	4	0	8	0
Tracks time to proper treatment if empiric therapy was started	5	3	0	4	6	0	6	0
Tracks adverse reactions to antibiotics	7	2	1	2	9	0	3	0
Reports resistance trends in facility antibiotics	10	1	0	1	7	0	4	1
Distributes a yearly antibiogram	10	0	1	1	2	1	8	1
Measures the cost of antibiotics	11	0	0	1	3	0	7	2
EDUCATION DOMAIN								
Provides education to clinicians and other relevant staff on antibiotic prescribing	9	1	2	0	8	0	4	0
BARRIERS DOMAIN								
Lack of funding	9	NA	0	3	8	NA	3	1
Lack of education	4	NA	5	3	8	NA	4	0
Lack of administrative support	5	NA	4	3	4	NA	8	0
Lack of time	7	NA	2	3	8	NA	4	0
Lack of information technology support	4	NA	5	3	4	NA	8	0
Provider opposition	4	NA	5	3	4	NA	8	0

Note: Responses of "yes" and "plan" are categorized as positive responses.
* Adapted from: Centers for Disease Control and Prevention (CDC). *Core elements of hospital antibiotic stewardship programs*. Atlanta: US Department of Health and Human Services; 2014. Also available at http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf

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- Reducing adverse effects of antibiotics, the incidence of *C. difficile*–associated diarrhea, and antibiotic resistance
- Improving pathogen susceptibility profiles

CMS regulations require antibiotic review as part of infection control programs in hospitals and LTCFs.[11,12] In conjunction with other infectious diseases and infection control societies, CDC describes the core elements of an antibiotic stewardship program as follows: (1) leadership support, (2) accountability, (3) drug expertise and key support for the stewardship program, (4) action to support optimal antibiotic use, (5) tracking and reporting antibiotic prescribing, use, and resistance, and (6) education.[1]

METHODS

Antibiotic stewardship practices in Pennsylvania acute care hospitals and LTCFs were analyzed based on responses from two sources: (1) the 2014 Annual Pennsylvania Hospital and Long-Term Care Facility User Survey and (2) the 2015 Antibiotic Stewardship Questionnaire of Implementation of Antibiotic Stewardship Practices.

2014 Annual User Survey

In the fall of 2014, as part of the Pennsylvania Patient Safety Authority annual survey, acute care hospitals and LTCFs statewide were queried about interest in and implementation of antibiotic stewardship programs.

2015 Antibiotic Stewardship Questionnaire

Over the first quarter of 2015, analysts queried a convenience sample of 12 Pennsylvania hospitals and 12 LTCFs that indicated that their facility has an antibiotic stewardship program in place. The purpose of conducting these questionnaires was to determine if stewardship practices were consistent with the best practices outlined in the CDC core elements of antibiotic stewardship program. The questionnaire was conducted using a combination of telephone, in-person, and e-mail communication. Responses of "yes" or "plan to implement" were identified as "positive" responses. See the Table.

RESULTS

2014 Annual User Survey

Of 172 hospital survey respondents, 77.3% (n = 133) indicated interest in learning more about antibiotic stewardship. Responses to the 2014 LTCF survey showed that 36.6% (n = 64 of 175) of the respondents had an antibiotic stewardship program in place. Analysis of survey responses also showed that 46.5% (n = 59 of 127) of LTCF respondents that were interested in participating in a statewide or regional collaboration were specifically interested in an antibiotic stewardship collaboration.

2015 Antibiotic Stewardship Questionnaire

Analysis of questionnaire responses from the 12 hospitals and the 12 LTCFs contacted showed that compared with the hospital respondents, fewer LTCFs had implemented all core elements of an antibiotic stewardship program in all six domains. See Figure 1.

Leadership support. Analysis of hospital responses to the three leadership questions revealed 75% (27 of 36) positive and plan-in-progress responses for implementation of the elements of leadership support, compared with 44% (16 of 36) for the LTCFs. Both the hospitals and LTCFs surveyed identified that the greatest opportunity for leadership improvement was in incorporating stewardship-related tasks in job descriptions and performance reviews. The LTCFs also identified an opportunity to improve formal leadership communication supporting improved use of antibiotics.

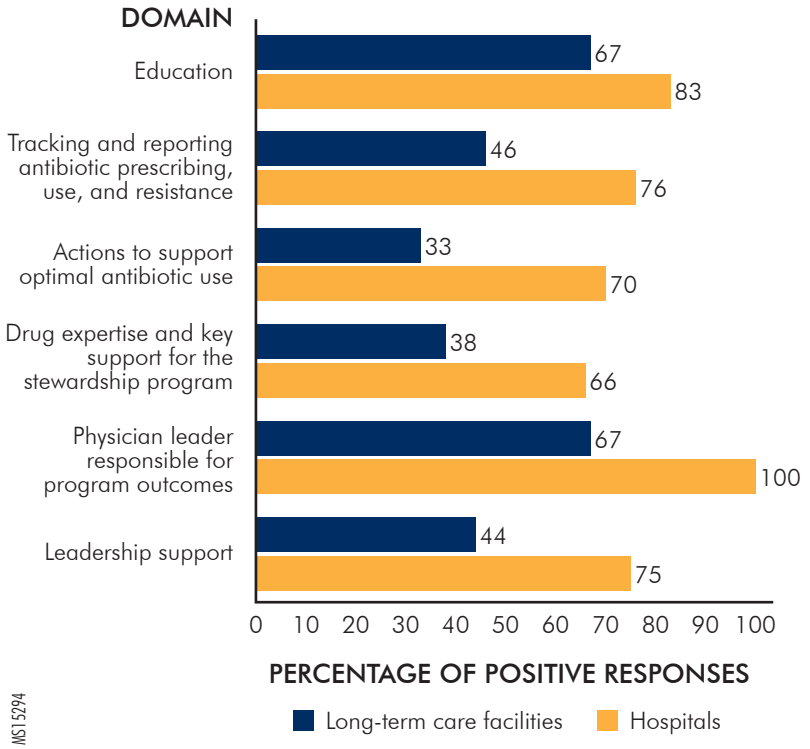
Physician leader responsible for program outcomes. Analysis of hospital responses to the one accountability question revealed 100% (12 of 12) positive and plan-in-progress responses for identification of a physician leader accountable for stewardship activities, compared with 67% (8 of 12) for the LTCFs.

Drug expertise and key support for the stewardship program. Analysis of hospital responses to the eight key support questions revealed 66% (63 of 96) positive and plan-in-progress responses for identification of key experts to support the stewardship program, compared with 38% (36 of 96) for the LTCFs. The hospitals identified that the greatest opportunity for improvement in key support for stewardship was involving quality improvement staff and department heads in working to improve antibiotic use. The LTCFs identified that the greatest opportunity for improvement was multidisciplinary support from the quality assurance and process improvement (QAPI) and the information technology departments.

Actions to support optimal antibiotic use. Analysis of hospital responses to the 13 specific questions on actions to improve antibiotic prescribing indicated 70% (109 of 156) positive and plan-in-progress responses for this domain, compared with 33% (52 of 156) for the LTCFs. The hospitals' greatest opportunities for improvement included 48-hour antibiotic time-outs and time-sensitive automatic-stop orders. The LTCFs' greatest opportunities for improvement were in implementing specific infection treatment and pharmacy interventions.

Tracking and reporting antibiotic prescribing, use, and resistance. Analysis of hospital responses to the 12 questions on how antibiotic prescribing, use, and

Figure 1. Positive Responses Regarding Implementation of Core Antibiotic Stewardship Elements, by Domain



Note: **Based on responses from 12 hospitals and 12 long-term care facilities to the Pennsylvania Patient Safety Authority's antibiotic stewardship questionnaire conducted in March 2015. The questionnaire is based on the Centers for Disease Control and Prevention's core elements of hospital antibiotic stewardship programs.* The data above reflects the percentage of positive and plan-in-progress responses to core element questions within the six domains of antibiotic stewardship: education (1 question); tracking and reporting antibiotic prescribing, use, and resistance (12 questions); actions to support optimal antibiotic use (13 questions); drug expertise and key support for the stewardship program (8 questions); physician leader responsible for program outcomes (1 question); and leadership support (3 questions).**

* Centers for Disease Control and Prevention (CDC). *Core elements of hospital antibiotic stewardship programs.* Atlanta: US Department of Health and Human Services; 2014.

resistance is tracked and monitored revealed 76% (109 of 144) positive and plan-in-progress responses to implementation of specific tracking and reporting stewardship actions, compared with 46% (66 of 144) for the LTCFs. Both the hospitals and the LTCFs identified that the greatest opportunity for improvement was tracking clinical outcomes to measure the impact of interventions. LTCFs also identified distribution of a yearly antibiogram, tracking clinical outcomes, and measuring the cost of antibiotic use as opportunities for improvement.

Education. Analysis of hospital responses to the one education question revealed 83% (10 of 12) positive and plan-in-progress responses to providing education on antibiotic prescribing, compared with 67% (8 of 12) for LTCFs.

Barriers to antibiotic stewardship. Analysis of responses to the six barrier questions found that both hospitals and LTCFs reported lack of funding and lack of time to be their most common challenges. LTCFs also noted lack of education as a barrier. See Figure 2.

STRATEGIES TO ASSESS KEY COMPONENTS OF A STEWARDSHIP PROGRAM

Successful stewardship process measures involve implementing a systematic assessment of the core elements of a stewardship program and periodic assessment of the treatment of infections.[5,13] Initial steps to this approach begin with using a standardized assessment to measure the level of integration of stewardship best practices and administrative support for the program. Detecting the gaps in current practice, support, accountability, monitoring, and resources enables both hospitals and LTCFs to define specific targets for intervention and to take action to close performance gaps.

Hospital Assessment

The CDC *Core Elements of Hospital Antibiotic Stewardship Programs* is accompanied by a checklist to help healthcare facilities assess integration of the core elements into their antibiotic stewardship programs.[11] The CDC checklist can be found online at http://www.cdc.gov/getsmart/healthcare/pdfs/checklist.pdf. The core elements of the CDC stewardship program, as well as actions to support optimal antibiotic use, include the following:[1,11]

Leadership support. Distribute a formal written statement of support, dedicated personnel, and financial and information technology resources to improve antibiotic prescribing.

Accountability. Appoint a physician leader responsible for program outcomes.

Drug expertise. Appoint a pharmacist responsible for improving antibiotic use.

Key support. Work with clinical, infection prevention, quality improvement, laboratory, and information technology leaders to improve antibiotic use in the facility. Base written policies to support optimal antibiotic prescribing on national guidelines and facility antibiograms, and require prescribers to document dose, duration, and indication for antibiotics.

Broad interventions to support optimal antibiotic use. Complete an "antibiotic time-out" (a review of appropriateness of antibiotics within 48 hours after initial orders), and establish preauthorization processes for specific antibiotic agents and prospective case review of antibiotic orders by a physician or pharmacist.

Pharmacy-driven strategies to support optimal antibiotic use. Implement automatic changes from intravenous to oral therapy, dose adjustments for organ dysfunction, therapeutic drug monitoring, and dose optimization for highly drug-resistant bacteria. Additional pharmacy interventions include instituting automatic alerts for simultaneous use of multiple agents with overlapping activity and time-sensitive stop orders.

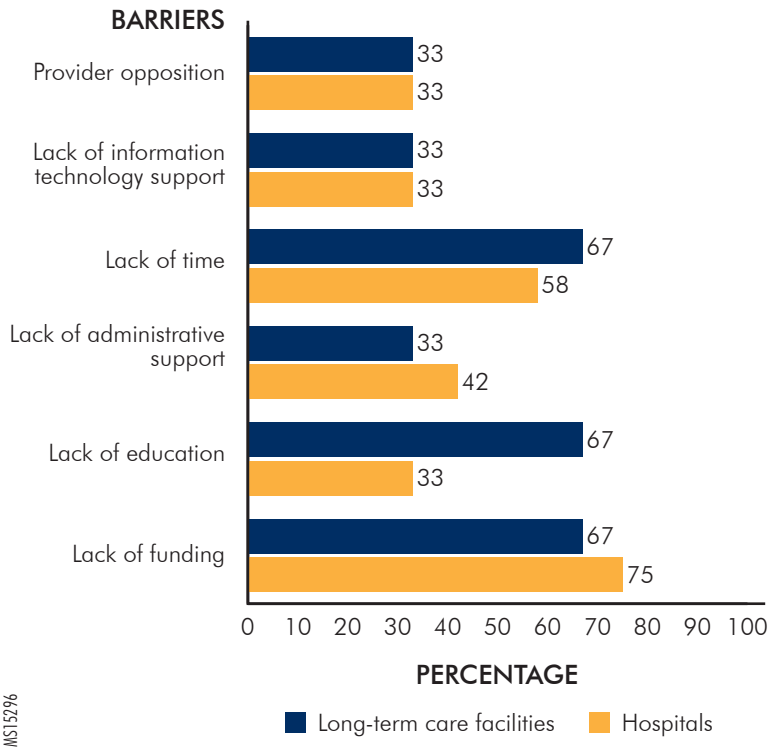
Diagnosis and infection-specific strategies to support optimal antibiotic use. Implement specific interventions to improve prescribing for specific conditions, such as pneumonia, urinary tract infections, and skin and soft-tissue infections. These syndromic management interventions also include empiric coverage for methicillin-resistant *Staphylococcus aureus*, treatment guidelines for *C. difficile* infections, and tailoring treatment for culture-proven invasive infection.

Tracking antibiotic prescribing, use, and resistance. Measure the impact of strategies to improve antibiotic use, including monitoring antibiotic prescribing and adherence to the documentation policy and treatment recommendations, tracking incidence of *C. difficile* infections, and producing an antibiogram. Monitoring antibiotic use also includes tracking days of individual antibiotic therapy, the number of grams of antibiotic used daily, and the cost of antibiotics used.

Reporting information. Share antibiograms and facility-specific and personalized antibiotic-use reports with prescribers.

Regular educational updates. Provide a foundation of knowledge about prescribing, resistance, and infectious-disease management to influence prescribing behavior. Education is most effective when accompanied by implementation of strategies and feedback of process and outcome measures.

Figure 2. Barriers to Implementation of Antibiotic Stewardship Activities



Note: **Based on responses from 12 hospitals and 12 long-term care facilities to the Pennsylvania Patient Safety Authority's antibiotic stewardship questionnaire conducted in March 2015. The questionnaire is based on the Centers for Disease Control and Prevention's core elements of hospital antibiotic stewardship programs.***

* Centers for Disease Control and Prevention (CDC). *Core elements of hospital antibiotic stewardship programs*. Atlanta: US Department of Health and Human Services; 2014.

LTCF Assessment

Results of the convenience sample suggest that LTCFs may face greater challenges than hospitals. Clearly there are differences between acute and long-term care settings. Nursing home administrators and medical directors need to know what to do to effect change. Because the resources and expertise in LTCFs can vary, a stepwise approach to stewardship

may be appropriate to control antibiotic overuse and resistance.

The CMS regulatory requirements for LTCFs note that antibiotic review should be part of the infection control program.[10] How does an LTCF judge if any of these core elements are appropriate in long-term care, and what kind of data can an LTCF collect and measure that will show success? A variety of approaches from the CDC core measures for hospitals may be appropriate for antibiotic stewardship programs in LTCFs. Assess antibiotic appropriateness and identify gaps in practice by focusing on the following steps:[5]

- Apply accurate diagnostic criteria.
- Prescribe the recommended agent for indication.
- Document indications and planned duration of therapy.
- Obtain cultures and relevant tests prior to treatment.
- Modify antibiotic choices appropriate to microbiologic findings.
- Ensure that treatment is compliant with facility policy on documentation of dose, duration, indication, antibiotic time-outs, and therapy reassessment.

The use of antibiotic stewardship program interventions should generally be targeted to institutional needs and resource availability:[5]

- Passive monitoring of antibiotic resistance is accomplished by reviewing lab results, facility antibiograms, and usage patterns, such as antibiotics orders, route of administration, therapy based on cultures, and antibiotics ordered by phone.
- Front-end approaches influence the initial choice of an antibiotic, such as having an institutional formulary, developing infection-specific treatment algorithms, or using antibiotic order forms requiring prescriber justification and preauthorization for select antibiotics.
- Back-end approaches involve activities such as regular feedback to prescribers and individual prescriber case reviews of the appropriateness of antibiotic use.
- Multifaceted education, such as small-group interactive sessions, videos, written materials, outreach visits, and one-to-one interviews with physicians, has been found to reduce antibiotic prescriptions for urinary tract infections when combined with a diagnostic and treatment algorithm.[5,14]

Antibiotic stewardship is ideally an area for QAPI activities in the LTCF setting. An effective, involved medical director acting as champion would also be critical for the program's success.

CONCLUSION

The growing problems of antibiotic resistance and *C. difficile* infection, as well as antibiotic treatment failures, increased lengths of stay, increased morbidity and mortality, and adverse effects of antibiotic therapy, can be minimized by programs dedicated to improving antibiotic prescribing. Antibiotic utilization can be enhanced by implementation of key elements of an effective antibiotic stewardship program.

Antibiotic stewardship programs help to ensure optimal treatment for patients with infections in both hospitals and LTCFs and may enhance the length of time antibiotics in current use remain effective. The first step in developing an effective antibiotic stewardship program is to conduct a standardized assessment to identify practice gaps and potential areas for improvement. Guidance on implementation of specific strategies for addressing practice gaps and opportunities for improvement will be presented in future *Pennsylvania Patient Safety Advisory* articles.

NOTES

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