

epiTRENDS

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Antimicrobial Resistance

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"...the microbes are educated to resist penicillin and a host of penicillin-fast organisms is bred out. ... In such cases the thoughtless person playing with penicillin is morally responsible for the death of the man who finally succumbs to infection with the penicillin-resistant organism. I hope this evil can be averted."

Sir Alexander Fleming, *New York Times*,
1945

A multi-pronged approach is essential to prevent, detect, and control the emergence of antimicrobial resistant organisms. A central element of the approach is antimicrobial stewardship. This epiTRENDS provides overview of an antimicrobial stewardship program, and presents potential roles of public health agencies in implementation of antimicrobial stewardship programs in healthcare settings.

Emergence of Antimicrobial Resistance

Emergence and spread of antimicrobial resistance has escalated at an alarming rate since the initial detection in 1945 of penicillin resistance in *Staphylococcus aureus* in clinical isolates soon after the introduction of the antibiotic. Compounded by depleted development and approval of new antibacterial drugs resulting in limited new therapeutic options in the near future, our ability to treat infections has been compromised. Not only do resistant infections result in increased morbidity and mortality, they also dramatically increase healthcare costs.

Whenever antimicrobials are used, biological pressures are exerted on microbes that promote their development of resistance. The few organisms that gain biological mechanisms to tolerate the antibiotic will survive and then dominate the microbial population. Antibiotic resistant pathogens become progressively more difficult to eradicate, necessitating more expensive or complicated therapeutic interventions. Such organisms are a threat not only to the patient but may also be transmitted to others, particularly among patients in healthcare settings. In addition, the genetic resistance mechanism may be appropriated by other microbial species,

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resulting in additional antibiotic resistant organisms. Use of antibiotics in animals is another potential route for the development of resistant strains.

Although antimicrobials have been instrumental in preventing and treating infectious disease, as much as 50% of antimicrobial use is inappropriate due to misprescription from clinicians (for example, a patient is given the wrong dose) or noncompliance by patients who do not complete the full course of antibiotics. The outcome may be harmful to the individual patient and such antimicrobial misuse also has the potential to promote the emergence of a multidrug-resistant organism.

***epi*TRENDS Monthly Posting Alert**

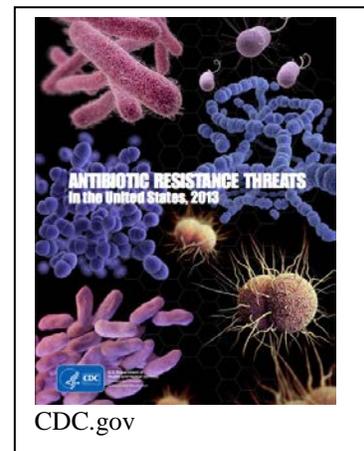
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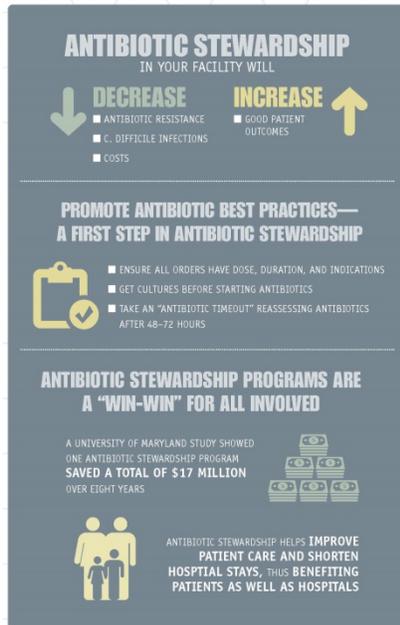
Underscoring the seriousness of antimicrobial resistance as a health

threat to individuals as well as the public, the Centers for Disease Control and Prevention (CDC) identified antibiotic resistance and advanced molecular detection as one of the five most urgent priorities for 2014. In addition, the CDC reported a first-ever snapshot of the burden and threats posed by the antimicrobial resistant organisms that have the greatest impact on human health, as well as the potential catastrophic consequences of inaction. For example, carbapenem-resistant Enterobacteriaceae (CRE) are categorized as an urgent threat, along with *Clostridium difficile* and drug-resistant *Neisseria gonorrhoeae*. CRE as an emerging public health threat and our surveillance of CRE in Washington were recently discussed in *epi*TRENDS (July 2012 and July 2013).



Antimicrobial Stewardship

As defined by Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA), antimicrobial stewardship refers to “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.” CDC designates antimicrobial stewardship as the “commitment to always use antibiotics appropriately and safely—only when they are needed to treat disease, and to choose the right antibiotics and to administer them in the right way in every case.”



www.cdc.gov

The overarching objectives of antimicrobial stewardship are:

- To ensure responsible antimicrobial prescription and use
- To improve patient outcomes while minimizing toxicity and other adverse events
- To reduce resistance to antimicrobials
- To decrease the spread of infections caused by multidrug-resistant organisms
- To reduce overall costs for a healthcare facility

The multidisciplinary and cooperative components essential to antimicrobial stewardship include:

- Infectious disease physicians
- Infection-control specialists
- Microbiology laboratory personnel
- Clinical pharmacists
- Public health agencies

Role of Public Health Agencies

Interventions to improve appropriate antibiotic use and to reduce the likelihood that organisms develop antibiotic resistance can be implemented in all healthcare settings regardless of facility size. Appropriate use of antibiotics contributes to patient safety while sustaining the availability of effective antibiotics.

Public health agencies, both at local and state levels, are in a unique position to support development of antimicrobial stewardship programs in a wide range of healthcare settings.

The following are some actions that the public health agencies can undertake:

- Help hospitals track antibiotic use and resistance.
- Share prescribing improvement recommendations and tools with clinicians and administrators. www.cdc.gov/getsmart/healthcare
- Support networks testing new prescribing improvement strategies.
- Help create regional programs to improve antibiotic prescribing.
- Gain an understanding of antibiotic stewardship activities in the state or area.
- Facilitate efforts to improve antibiotic prescribing and prevent antibiotic resistance.
- Provide educational tools to facilities to help prescribers improve practices.

From CDC Vital Signs, March 4, 2014 <http://www.cdc.gov/vitalsigns/antibiotic-prescribing-practices/index.html>

The Future

“Ecological instabilities arise from the ways we alter the physical and biological environment, the microbial and animal tenants (humans included) of these environments, and our interactions (including hygienic and therapeutic interventions) with the parasites. The future of humanity and microbes likely will unfold as episodes of a suspense thriller that could be titled Our Wits versus Their Genes.”

Dr. Joshua Lederberg, *Science*, 2000



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With concentrated efforts and commitment from the multidisciplinary contributors to an antimicrobial stewardship program, the current rate of emergence and spread of antimicrobial resistance can be reduced. Antimicrobial stewardship programs practiced at the facility-level have resulted in decreased occurrences of *C. difficile* infections. Reflecting the importance of antibiotic stewardship programs, readers are encouraged to peruse the many excellent sources of information and resources that are available on-line. A representative selection is listed below.

<http://www.cdc.gov/drugresistance/>

<http://www.cdc.gov/getsmart/healthcare/>

<http://www.cdc.gov/narms/get-smart.html>

http://www.idsociety.org/stewardship_policy/

<http://cid.oxfordjournals.org/content/44/2/159.full>

http://cid.oxfordjournals.org/content/53/suppl_1/S8.full

<http://www.shea-online.org/PriorityTopics/AntimicrobialStewardship.aspx>

<http://online.stanford.edu/course/antimicrobial-stewardship-optimization-antibiotic-practices>

(excellent 6 hour on-line course from Stanford University. Free.)