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## OVERVIEW

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Since the introduction of penicillin in the 1940s, antimicrobial drugs have played a major role in effectively controlling infectious diseases, especially those caused by bacteria. Soon after the introduction of antimicrobial drugs, however, some bacterial pathogens became resistant to many of these drugs. Initially, the problem of antimicrobial drug resistance (AMR) was solved by the discovery of new classes of drugs and by the chemical modification of previously existing drugs; unfortunately, the development of new antimicrobial drugs cannot keep pace with the ability of microorganisms to develop resistance.

AMR is a major problem around the world. AMR results in increased morbidity, mortality, and cost of health care; prolonged periods during which individuals are infectious; and greater opportunities for spread of infection to other individuals. The problem of AMR is troublesome both in developed and developing countries. But in developing countries, the availability and use of antimicrobials are poorly controlled, resulting in a high rate of resistance, particularly to the older generation of antimicrobials.

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## WHAT CAUSES AMR

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AMR is the product of:

- ◆ Excessive and unnecessary prescribing of anti-infective drugs by practitioners,
- ◆ Prescription of anti-infective drugs by poorly trained and unskilled personnel,
- ◆ The ready availability of anti-infective drugs without a need for prescription,
- ◆ Carriers of resistant organisms which may be passed to contacts,
- ◆ Inadequate hospital infection control practices,
- ◆ Inadequate surveillance,
- ◆ Use of expired drugs,
- ◆ Poor storage conditions,
- ◆ Poor or inadequate regulatory mechanisms,
- ◆ Poor adherence to therapeutic regimens by patients,
- ◆ Economic and political factors, and/or
- ◆ Counterfeit and substandard drugs.

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## MAGNITUDE OF THE PROBLEM

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AMR has been observed soon after the introduction of antimicrobial drugs. For example, the development of resistance to penicillin in *Staphylococcus aureus* by the production of a  $\beta$ -lactamase quickly decreased the usefulness of penicillin for

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serious staphylococcal infections. Subsequently, many bacterial pathogens have become resistant to many antimicrobial drugs.

Diseases such as tuberculosis, gonorrhea, malaria, childhood ear infections, and even HIV/AIDS are now more difficult to treat than they were decades ago. AMR is an especially difficult problem for hospitals because their critically ill patients, who are more susceptible to infections than the general population, may require more antimicrobials. Heavy use of antimicrobials in these patients hastens the mutations in microbes and other pathogens that bring about drug resistance. Unfortunately, this worsens the problem by producing bacteria with greater ability to survive even our strongest antimicrobials. These even stronger drug-resistant bacteria continue to prey on vulnerable hospital patients.

As an example, the evolution of AMR resistance in *S. aureus* is discussed below:

- ◆ *S. aureus* is the most common cause of surgical-wound infections and second only to coagulase-negative staphylococci as a cause of nosocomial bloodstream infection. After the initial success of penicillin in treating *S. aureus* infections, resistance began to emerge. Today, approximately 95% of *S. aureus* isolates are resistant to penicillin and ampicillin.
- ◆ Methicillin and other penicillins were successful in treating penicillin-resistant *S. aureus* infections until the 1980s, when methicillin-resistant *S. aureus* (MRSA) became endemic in many hospitals.
- ◆ MRSA has spread beyond the confines of health care facilities, emerging in the community. MRSA is currently the most commonly identified antibiotic-resistant pathogen in U.S. hospitals.
- ◆ Although some of *S. aureus* strains isolated from outpatients in the U.S. were methicillin-resistant, most of these strains were recovered from individuals who were likely to have acquired them in the health care environment. Though the association with health care may have been indirect, household contacts of individuals with hospital-acquired MRSA (HA-MRSA) are at significantly increased risk for MRSA colonization.
- ◆ In a recent and dramatic evolutionary development, however, infection with novel community-acquired strains of MRSA (CA-MRSA) in previously healthy individuals without either direct or indirect association with health care facilities has emerged as a new and important public health problem.
- ◆ Since the emergence of MRSA, the glycopeptide vancomycin has been the only uniformly effective treatment for staphylococcal infections. Yet in May 1996, the world's first documented clinical infection due to glycopeptide-intermediate

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*S. aureus* [VISA] was diagnosed in a patient in Japan; and soon thereafter, a report of VISA cases from the U.S. was published.

- ◆ In June 2002, the first clinical isolate of vancomycin-resistant *S. aureus* (VRSA) was reported from a patient in Michigan.

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### WHAT YOU CAN DO TO PREVENT AMR

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Nurses can and should play a major role in helping curb the spread of infectious diseases and the rising problem of AMR. To help reduce the problem of AMR in health care settings and in the community, appropriate preventive strategies should be implemented. Such strategies, which should be implemented with direct participation of health care professionals including nurses, include:

- ◆ **Prevent infection:** Vaccination of staff and patients in health care institutes against influenza and pneumococcal disease helps prevent infections requiring antimicrobial therapy.
- ◆ **Prevent self-medication:** In many developing countries antimicrobials can be purchased without prescription and buyers are often inadequately dosed. Without proper medical consultation, patients usually take these agents until they feel better, which may occur before the pathogen has been eliminated.
- ◆ **Purchase antimicrobials from legitimate sources:** Counterfeit and substandard drugs are major causes of treatment failure and AMR.
- ◆ **Target the pathogen:** Identifying the pathogen using microbiologic cultures and antimicrobial susceptibility testing allows for targeted antimicrobial therapy
- ◆ **Access the experts:** Input from experts on infectious diseases improves the outcomes of serious infections. Therefore, it is important to consult the appropriate experts for complicated infections.
- ◆ **Use local data:** The prevalence of AMR varies by locale. It is important to get previous microbiology results when patients transfer to another facility.
- ◆ **Reduce the use of vancomycin:** Reduction of vancomycin use is one of the most important strategies to limit the emergence, selection, and spread of vancomycin-resistant bacteria.
- ◆ **Treat infection, not contamination or colonization:** A major cause of antimicrobial overuse is treatment of contamination or colonization.
- ◆ **Support adherence to antimicrobial agents:** AMR is often due to failure to complete the prescribed course of therapy.
- ◆ **Stop antimicrobial treatment:** Stopping empiric therapy when cultures are negative can significantly reduce antimicrobial use.

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- ◆ **Educate patients about infection control practice:** Teach patients about the importance of their role in infection control including personal hygiene, hand hygiene, and recognizing signs of infection.
- ◆ **Follow infection control precautions:** Following the recommended infection control precautions for patients can prevent transmission of infection from patient to patient.

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### RELATED INFORMATION

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Additional information may be obtained from agencies involved in combating the problem of AMR. See selected links below for more information.

- ◆ U.S. Centers for Disease Control and Prevention (CDC)  
<http://www.cdc.gov/drugresistance/community/>
- ◆ U.S. Food and Drug Administration (US FDA)  
[http://www.fda.gov/oc/opacom/hottopics/anti\\_resist.html](http://www.fda.gov/oc/opacom/hottopics/anti_resist.html)
- ◆ U.S. National Institute of Allergy and Infectious Diseases  
<http://www.niaid.nih.gov/publications/antimic.htm>
- ◆ The World Health Organization (WHO) <http://www.who.int/drugresistance/en/>
- ◆ European Antimicrobial Resistance Surveillance System (EARSS)  
<http://www.earss.rivm.nl/>
- ◆ International Network for the Study and Prevention of Emerging Antimicrobial Resistance (INSPEAR)  
<http://www.cdc.gov/ncidod/hip/SURVEILL/inspear.HTM>
- ◆ Alliance for the Prudent Use of Antibiotics (APUA)  
<http://www.tufts.edu/med/apua/>
- ◆ The European Network for Antimicrobial Resistance and Epidemiology (ENCARE) <http://www.enare.org/>

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The Position Statement of the International Council of Nurses (ICN) on Antimicrobial Resistance supports these strategies. AMR is a serious threat to quality of care, and nurses with other health professionals and patients have a key role in reducing or preventing it.

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The International Council of Nurses is a federation of 125 national nurses' associations representing the millions of nurses worldwide. Operated by nurses for nurses, ICN works to ensure quality care for all and sound health policies globally. This document was published by the USP Drug Quality and Information Program, which focuses on ensuring the quality of pharmaceuticals and their informed and appropriate use worldwide, with the support of the U.S. Agency for International Development.

