Antibiotic Resistance

by Patricia Emanuele, RN, MSN, COHN-S

This article reviews the causes and consequences of antibiotic resistance and efforts to control its growth. Antibiotic-resistant infections and related morbidity and mortality are on the rise in the United States and around the world. At the same time, the effectiveness of many antibiotics has declined. Antibiotic resistance is a natural biological outcome of antibiotic use. Although it cannot be prevented, antibiotic resistance can be controlled. New health care reform laws focus on prevention and safety, offering occupational health nurses an opportunity to raise public awareness of antibiotic resistance and promote disease prevention in the workplace.

Antibiotics can save lives, but they also promote the development of antibiotic-resistant bacteria. The Centers for Disease Control and Prevention (CDC, 2010) states that antibiotic resistance is one of the world's most pressing public health problems; the number of bacteria resistant to antibiotics has increased in the past decade, and many bacterial infections are becoming resistant to the most commonly prescribed antibiotics. Resistant bacteria develop when antibiotics are used both appropriately and inappropriately. When antibiotics are used appropriately, most offending bacteria may be killed, but some become resistant and proliferate. When antibiotics are misused or overused, their effectiveness is reduced or eliminated.

ABOUT THE AUTHOR
Ms. Emanuele is occupational health nurse, Atlantic Health System, Morristown, NJ.
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Address correspondence to Patricia Emanuele, RN, MSN, COHN-S, 197 Potomac Drive, Basking Ridge, NJ 07920. E-mail: pae197@yahoo.com.
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RESISTANCE

Bacteria are living one-celled microbes with the ability to change and adapt for survival. These microbes can be both helpful and harmful. Bacteria are responsible for the production of dairy products such as cheese, yogurt, and sour cream. Nonpathogenic intestinal bacteria help absorb nutrients and fend off harmful, disease-causing bacteria. Antibiotics kill or slow the growth of bacteria and have reduced illness and death from many harmful bacterial infections since penicillin was first introduced in the 1940s. However, antibiotics also affect the body's nonpathogenic bacteria. Over time, harmful bacteria adapt and mutate to thrive in the presence of the medications designed to kill them, despite the introduction of new antibiotics. Bacteria, not individuals, become resistant to antibiotics. Antibiotic resistance is not a disease, but rather the result of antibiotics used for therapy or prophylaxis. The prevalence of antibiotic-resistant bacteria means that treatments for common infections become increasingly limited, costly, and even nonexistent. Further, the availability of new medications is diminished because pharmaceutical firms have not emphasized antibiotic development and few candidate medications are currently in development that offer benefits over existing medications (Infectious Diseases Society of America, 2009).

Misuse and overuse of antibiotics are the primary causes of the increase in antibiotic-resistant bacteria (CDC, 2010). Although antibiotic resistance cannot be prevented, it can be controlled. Some health care providers prescribe antibiotics for illnesses that cannot be treated or cured with antibiotics (e.g., viruses). The problem is compounded when antibiotics are prescribed for too short a time, at too low a dose, or at inadequate potency or when powerful broad-spectrum, rather than narrow-spectrum, antibiotics are used. Overuse of antibiotics for prophylaxis, consumer demand for antibiotics when they are not needed, and failure to complete an entire course of prescribed antibiotics increase the growth of antibiotic-resistant bacteria. Livestock producers feed antibiotics to healthy animals to promote growth and compensate for unsanitary conditions. This elective use of antibiotics for non-illness purposes causes antibiotic-resistant bacteria to affect individuals through the

Appropriate Antibiotic Use

1. Talk with your health care provider about antibiotic resistance:
    a. Ask whether an antibiotic is likely to be beneficial for your illness.
    b. Ask what else you can do to feel better sooner.
2. Do not take an antibiotic for a viral infection such as a cold or influenza.
3. Do not save some of your antibiotic for the next time you get sick.
4. Discard any leftover medication once you have completed your prescribed course of treatment.
5. Take an antibiotic exactly as the health care provider tells you. Do not skip doses.

Note. *Data from the Centers for Disease Control and Prevention, 2009a.*

consumption of contaminated food or through the environmental effects of farm waste run-off. Particularly vulnerable are slaughterhouse workers, farmers, and farm families.

Antibiotic-resistant infections are acquired in two ways: they are contracted from a contaminated outside source or result from using antibiotics (Lewis, 1995). Outside sources may include infected individuals, food, water, and environmental surfaces and poor hygiene. Antibiotic-resistant infections can also emerge when nonpathogenic intestinal bacteria are killed by ingested antibiotics. These infections are difficult to treat and can be life-threatening. They can affect individuals who are ill as well as those who are seemingly healthy. Surgical and dialysis centers, hospitals, and nursing homes are common environments for antibiotic-resistant microbes, and the most vulnerable populations include children, the elderly, and those with compromised immune systems. However, community spread of antibiotic-resistant infections is also possible. Workplace areas with increased risk for disease transmission include lunch rooms and gyms—any place where employees eat or share equipment or materials.

COSTS OF ANTIBIOTIC RESISTANCE

Although antibiotic resistance cannot be prevented, slowing its growth reduces side effects associated with antibiotic-resistant infections. Personal, social, and economic consequences of antibiotic-resistant infections include longer illnesses, longer hospital stays, increased opportunity for transmission, and increased need for new antibiotics. Antibiotic-resistant infections are costly. A recent study found that antibiotic-resistant infections cost the U.S. health care system more than $20 billion annually and society more than $35 billion and lead to more than 8 million additional hospital days (Roberts et al., 2009). Antibiotic-resistant diseases include tuberculosis, malaria, methicillin-resistant *Staphylococcus aureus* (MRSA), *Streptococcus pneumoniae*, gonorrhea, typhoid fever, vancomycin/glycopeptide-intermediate *Staphylococcus aureus* (VISA/GISA), and vancomycin-resistant *Enterococci* (VRE) (CDC, 2009b). Improved prescription protocols for antibiotics, education, and infection control can slow rising antibiotic resistance of these and other bacteria.

GLOBAL CONCERN

Antibiotic resistance is a global concern due to growth in international trade and travel. In some countries, antibiotics can be purchased without prescriptions. Some antibiotics may be sold over the Internet or obtained for pets; some may be purchased at ethnic stores, having been obtained from foreign countries. Various global organizations are acting to prevent the spread of antibiotic resistance. Europe and the United States recently established a task force to improve the therapeutic use of antibiotics and prevent antibiotic-resistant infections. The CDC, a leader in raising awareness of antibiotic resistance, has an educational campaign named Get Smart: Know When Antibiotics Work. A coalition, Keep Antibiotics Working, includes concerned health, consumer, agricultural, and environmental organizations, focuses on reducing antibiotic resistance, and supports the elimination of antibiotics from animal feed. The Food and Drug Administration urges prescribers to use antibiotics judiciously and to communicate to clients the importance of taking the full course of prescribed antibiotics. The Infectious Diseases Society of America advocates the development of 10 new antibiotics by 2020 because few candidate drugs are currently in development to treat resistant infections (Infectious Diseases Society of America, 2009). The Alliance for the Prudent Use of Antibiotics works to preserve the power of antibiotics. Many other organizations and individuals are also working to control antibiotic resistance.

All health care workers must be concerned about antibiotic resistance and disease prevention. Improved diagnostic tests to identify bacteria, new vaccines and medications to prevent and treat bacterial infections, and investigations of alternative methods for attacking bacteria are needed. Probiotics, available as dietary supplements, are live bacteria or yeasts thought to prevent and reduce intestinal disorders and antibiotic-associated diarrhea. The CDC (2009a) is currently monitoring the role of probiotics in preventing drug-resistant infections; however, it has no recommendations for their use currently.

IMPLICATIONS FOR OCCUPATIONAL HEALTH NURSES

Antibiotic resistance has significant implications for occupational health nurses. Occupational health nurses contribute to the surveillance,

detection, and containment of and response to disease outbreaks at the worksite. They can promote prudent antimicrobial use, provide employee education, and support infection control measures to limit antibiotic resistance.

Prevention of infection is paramount. Hygienic public health measures and infection control strategies are vital. Occupational health nurses can encourage healthy lifestyle habits, including proper diet, rest, exercise, and hygiene. Hand washing is the most powerful defense against infection. The difference between bacteria and viruses can be explained, and employees can be informed that most upper respiratory infections are caused by viruses, which are not killed by antibiotics. Employees must understand that antibiotics are usually not needed for a child's runny nose or most cases of otitis media with effusion (CDC, 2010).

Promotion of vaccinations, especially the annual influenza vaccination, helps to avoid illness and the use of antibiotics. Occupational health nurses can stress illness prevention strategies, suggest self-care measures to follow during illness, and discuss appropriate antibiotic use to reduce antibiotic resistance (Sidebar).

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