

Antibiotic Resistance

Introduction and Epidemiology

The Institute of Medicine has identified antibiotic resistance as one of the key microbial threats to human health. Since the advent of antibiotic therapy, millions of lives have been saved as a result. However, emergence of antibiotic resistance threatens to make many infectious diseases untreatable.

Antibiotic resistance is a problem in all health care settings, including long-term care facilities. Each year, approximately 250,000 residents of long-term care facilities develop infections. 27,000 of these infections are resistant to at least one class of antibiotics used to treat them.¹

Antibiotic Resistance and Long-Term Care

Emergence of antibiotic resistance in long-term care facilities is likely due to a number of factors. As many residents of long-term care are older and have chronic medical conditions or impaired immune function, they are more prone to infections in general. Risk is increased by the use of invasive medical devices such as indwelling urinary catheters and long-term vascular access devices. Close contact with other individuals may also promote the spread of resistant organisms. As many patients are transferred to and from acute care hospitals, resistant strains of bacteria can spread between facilities.

One major factor driving the emergence of antibiotic resistance is usage of antibiotics. In long-term care, infections such as urinary tract infection and pneumonia are a common cause of morbidity and mortality. However, studies have shown that antibiotics are often prescribed inappropriately in the long-term care setting. It is estimated that up to 75% of antibiotic use in long-term care facilities is inappropriate.² Examples of inappropriate antibiotic use in long-term care include asymptomatic bacteriuria and viral upper respiratory tract infection.

Trends in Antibiotic Resistance

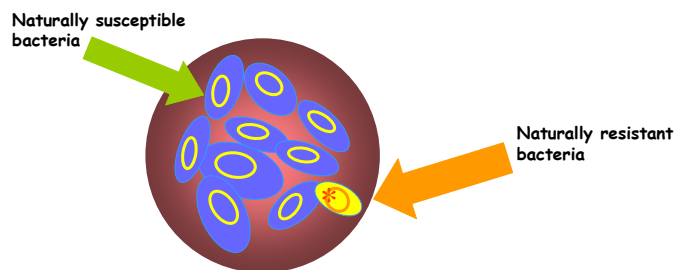
Surveillance data has shown steady increases in rates of antibiotic resistance for several pathogens, particularly in the acute-care setting. Since 1990, the prevalence of methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *enterococci*, 3rd generation cephalosporin resistant *Klebsiella*, and penicillin-resistant *Pneumococcus* has been increasing nationally.³

While much of the data regarding emergence of antibiotic resistance is from the acute care setting, many long-term care facilities have also reported increases in drug-resistant pathogens. As an example, since the widespread use of fluoroquinolones began in the 1990, rates of resistance to this

class of antibiotics have increased in several long-term care facilities.⁴

Pathogenesis

The biological mechanisms by which organisms become resistant to antibiotics vary depending on the organism. Bacteria can become resistant through genetic mutation or genetic transfer.



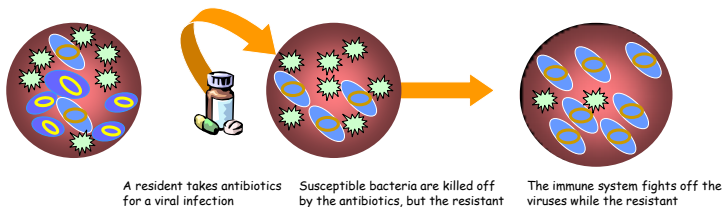
If bacteria with resistant genes are exposed to antibiotics, the antibiotics will kill the susceptible bacteria, allowing the resistant ones to survive and multiply. If these antibiotic-resistant bacteria result in an infection, the infection may be more serious and difficult to treat with routine antibiotics.

The following diagram shows how misuse of antibiotics (not finishing a prescription or taking antibiotics for a viral infection) causes antibiotic-resistant bacteria to multiply.

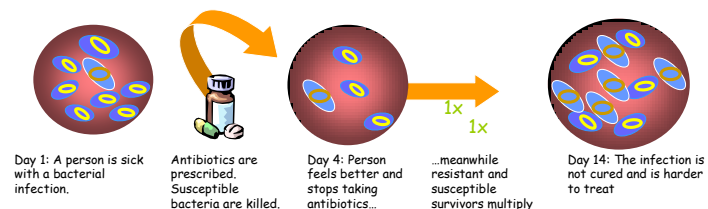
Here are the players:

- Virus
- Naturally Resistant Bacteria
- Susceptible Bacteria

Taking antibiotics for a viral infection:



Not finishing the full course of antibiotics can also lead to antibiotic resistance:



www.minnesotaarc.org

Members of MARC include Blue Cross and Blue Shield of Minnesota, HealthPartners, Medica, Minnesota Council of Health Plans, Minnesota Department of Health, Minnesota Medical Association, Minnesota Pharmacists Association, StratisHealth, and UCare Minnesota.



This document was last modified on 7/19/2007.

Antibiotic Resistance

Consequences of Antibiotic Resistance

The emergence of antibiotic resistance has consequences both for individual patients as well as the broader public health. Patients with infections caused by antibiotic-resistant pathogens often have worse clinical outcomes compared to patients with antibiotic-sensitive infections. For example, a study of *Staphylococcus aureus* bacteremia showed a near doubling of mortality odds for methicillin-resistant infection vs. methicillin-sensitive infection.⁵ In long-term care facilities, antibiotic-resistant infections have been shown to be more expensive to treat than antibiotic-sensitive infections.⁶ Other studies have shown that patients with bacteremia who initially receive an antibiotic to which the organism is resistant have worse clinical outcomes.⁷

As a result of the emergence of antibiotic resistance, empiric therapy is often broadened to cover for the possibility of resistant pathogens. This is often necessary, particularly in very ill patients, but also has negative consequences of contributing to higher cost of care and promoting the development of antibiotic resistance. Unfortunately, development of new antibiotics by the pharmaceutical industry has decreased over the past several years.⁸ This combination of factors threatens treatment options for many infections in the near future.

Preventing Antibiotic Resistance

Many steps can be taken to prevent the emergence of antibiotic resistance and the spread of antibiotic-resistant pathogens. Attention to and adherence to hand-hygiene guidelines can decrease transmission of resistant organisms. A study of a 255-bed facility observed staff-resident interactions and found that staff washed their hands 27% of the time it was needed before interacting with a resident.⁹ They further determined that microbes could be transmitted from staff to residents in 82% of the staff-resident interactions.⁹

Managing antibiotic use appropriately has also been shown to have beneficial effects on antibiotic resistance. In a 1997 study from Finland, erythromycin resistance rates in *Group A streptococcus* decreased from 19.0% to 8.6% as a result of implementation of national guidelines which reduced macrolides use significantly.¹⁰ Another study from Iceland showed decreases in penicillin-resistant *Pneumococcus* rates in coordination with a public and physician education campaign.¹¹

Appropriate usage of antibiotics can be facilitated by careful attention to the diagnostic process, and prescribing of antibiotics only when clinically indicated. Cultures and antibiotic susceptibility testing should be obtained whenever possible to help guide therapy. Patients on broad spectrum antibiotic therapy should have their therapy narrowed based

on culture results once available. These steps can help prevent the further emergence of antibiotic resistance.

References

- ¹ Centers for Disease Control
<http://www.cdc.gov/drugresistance/healthcare/lrc.htm>
- ² Nicolle LE, Bentley DW, Garibaldi R, Neuhaus EG, Smith PW. Antimicrobial use in long-term-care facilities. SHEA Long-Term-Care Committee. *Infect Control Hosp Epidemiol.* Aug 2000;21(8):537-545.
- ³ NNIS data – need exact reference
- ⁴ Viray, M., D. Linkin, J. N. Maslow, D. D. Stieritz, L. S. Carson, W. B. Bilker, and E. Lautenbach. 2005. Longitudinal trends in antimicrobial susceptibilities across long-term-care facilities: emergence of fluoroquinolone resistance. *Infect. Cont. Hosp. Epidemiol.* 26:56-62.
- ⁵ Cosgrove SE, Sakoulas G, Perencevich EN, et al. Comparison of Mortality Associated with Methicillin-Resistant and Methicillin-Susceptible *Staphylococcus aureus* Bacteremia: A Meta-analysis. *Clin Inf Dis* 2003; 36:53-59.
- ⁶ Capitano B, Leshem A, Nightingale CH, et al. Cost Effect of Managing Methicillin-Resistant *Staphylococcus Aureus* in a Long-Term Care Facility. *JAGS* 2003; 51(1):10-16.
- ⁷ Ibrahim EH, Sherman G, Ward S, et al. The influence of inadequate antimicrobial treatment of bloodstream infections on patient outcomes in the ICU setting. *Chest* 2000; 118(1):146-155.
- ⁸ Spellberg B, Powers JH, Brass EP, et al. Trends in Antimicrobial Drug Development: Implications for the Future. *Clin Inf Dis* 2004; 38:1279-1286.
- ⁹ Thompson BL, Dwyer DM, Ussery XT, Denman S, Vacek P, Schwartz B. Handwashing and glove use in a long-term-care facility. *Infect Control Hosp Epidemiol.* Feb 1997;18(2):97-103.
- ¹⁰ Seppala H et al. The Effect of Changes in the Consumption of Macrolide Antibiotics on Erythromycin Resistance in Group A Streptococci in Finland. *New Eng J Med* 1997; 337:441-6.
- ¹¹ Stephenson J. Icelandic researchers are showing the way to bring down rates of antibiotic-resistant bacteria. *JAMA.* 1996;275:175.



www.minnesotaarc.org

Members of MARC include Blue Cross and Blue Shield of Minnesota, HealthPartners, Medica, Minnesota Council of Health Plans, Minnesota Department of Health, Minnesota Medical Association, Minnesota Pharmacists Association, StratisHealth, and UCare Minnesota.



This document was last modified on 7/19/2007.