

THE BAD SIDE OF GOOD DRUGS

ANTIBIOTIC RESISTANCE



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THE READER WILL BE ABLE TO...

- Define what an antibiotic drug resistant bacteria is
- Describe three reasons why antibiotic resistance occurs
- Explain three ways to prevent antibiotic resistance
- Recall how antibiotics work
- Name three current drug resistant bacteria



DISCOVERY OF ANTIBIOTICS...

- In the 1920s, British scientist Alexander Fleming was working in his laboratory at St. Mary's Hospital in London when, almost by accident, he discovered a naturally growing substance that could attack certain bacteria
- In one of his experiments in 1928, Fleming observed colonies of the common *Staphylococcus aureus* bacteria that had been worn down or killed by mold growing on the same plate or petri dish
- He determined that the mold made a substance that could dissolve the bacteria. He called this substance penicillin, named after the *Penicillium* mold that made it



DISCOVERY OF ANTIBIOTICS...

- Fleming and others conducted a series of experiments over the next 2 decades using penicillin removed from mold cultures that showed its ability to destroy infectious bacteria.
- Starting in 1941, scientists found that even low levels of penicillin cured very serious infections and saved many lives
- For his discoveries, Alexander Fleming won the Nobel Prize in Physiology and Medicine



WHAT ARE ANTIBIOTICS?

- Antibiotics, also known as antimicrobial drugs, are drugs that fight infection caused by a **bacteria**
- After the use of antibiotics in the 1940s, this new drug reduced illness and death from infectious diseases
- The term antibiotic originally referred to a natural compound produced by a fungus or another microorganism that kills bacteria which cause disease in humans and animals.



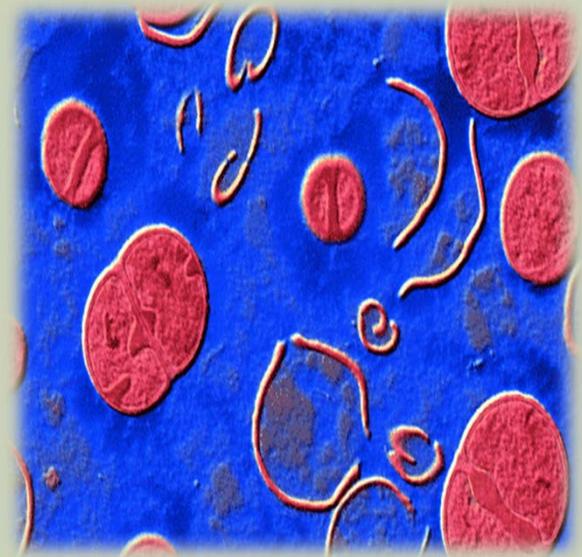
WHAT ARE ANTIBIOTICS?

- Antibiotics have been used for the last 70 years to treat patients who have **bacterial infections**
- Antibiotic use has been beneficial when prescribed and taken properly
- These drugs have been used so widely and for so long that the bacteria that antibiotics are designed to kill have adapted to them, making the drugs less effective



HOW ANTIBIOTICS WORK...

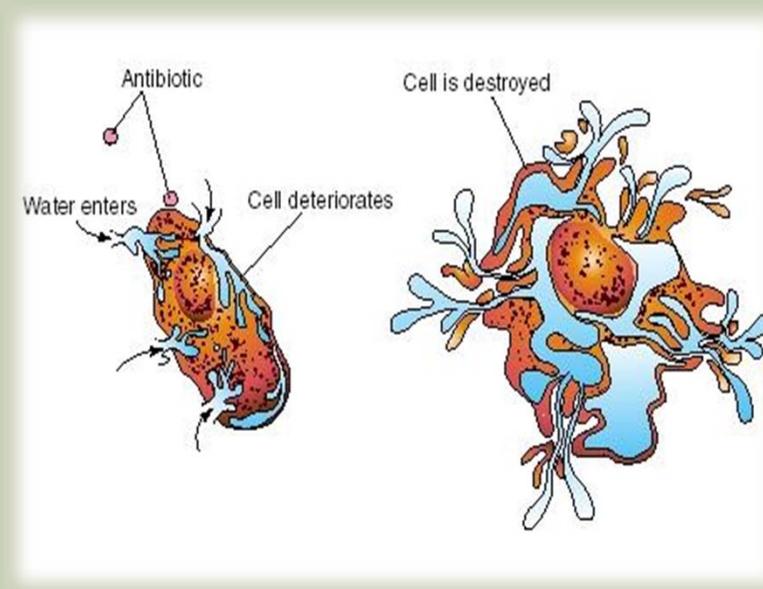
- Some antibiotics (e.g., penicillin, cephalosporin) kill bacteria outright and are called bactericidal:
 - They may directly attack the bacterial cell wall, which injures the cell
 - The bacteria can no longer attack the body, preventing these cells from doing any further damage within the body



The effects of the antibiotic drug on *Staphylococcus aureus* bacteria. The antibiotic kills the bacteria (red) by causing the cell wall to disintegrate (yellow remnants).

HOW ANTIBIOTICS WORK...

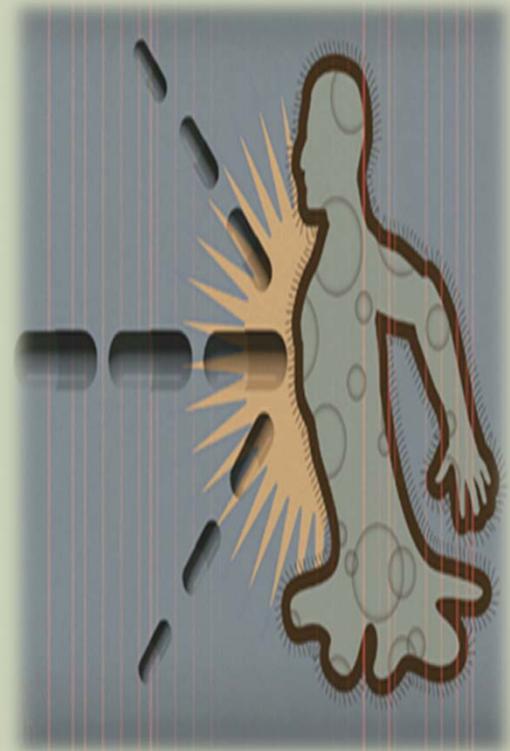
- Other antibiotics (e.g., tetracycline, erythromycin) block the bacteria's growth or reproduction:
 - Often called bacteriostatic antibiotics, they prevent nutrients from reaching the bacteria, which stops them from dividing and multiplying
 - Because millions of bacteria are needed to continue the disease process, these antibiotics can stop the infection and give the body's own immune system time to attack



Source: Encyclopedia of Surgery

WHAT IS DRUG RESISTANCE...

- Antibiotic resistance is the ability of bacteria or other infectious diseases to resist the effects of an antibiotic
- Antibiotic resistance occurs when a bacteria changes in some way that reduces or eliminates the effectiveness of the drug
- The bacteria survives and continues to multiply causing more harm to the person



WHAT IS DRUG RESISTANCE...

- Some bacteria have developed resistance to a single antibiotic, while others develop resistance to several different types of antibiotics
- These bacteria are often referred to as multidrug-resistant or MDR strains
- In some cases, the bacteria have become so resistant that no available antibiotics are effective against them



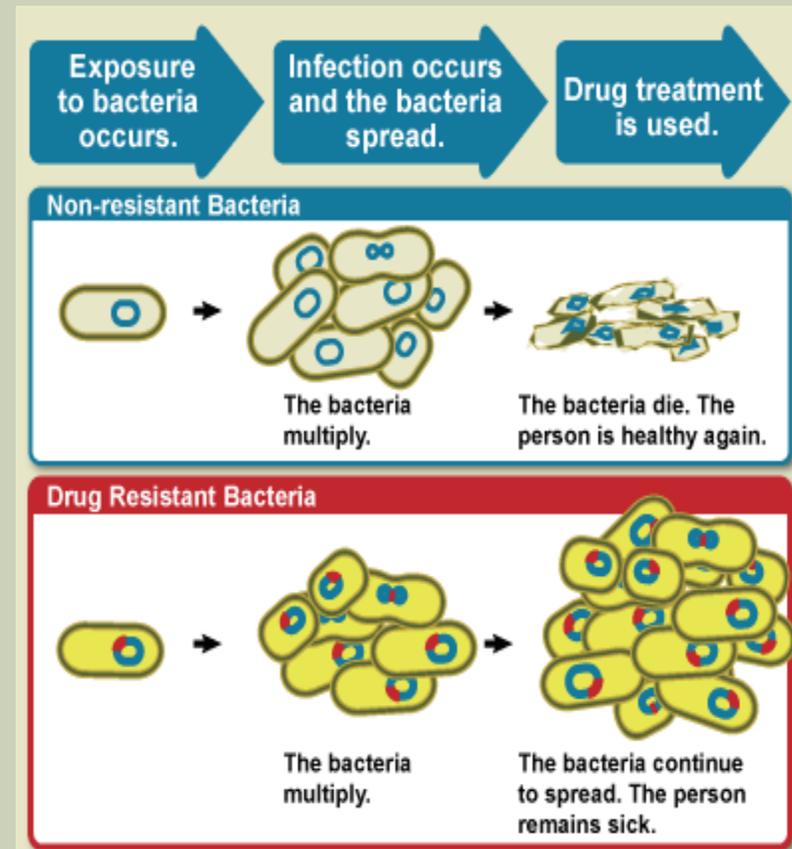
DRUG RESISTANCE...

- Antibiotic drug resistance occurs everywhere in the world
- Hospitals and other healthcare settings are battling drug-resistant organisms that spread inside these institutions
- Drug-resistant infections, such as drug-resistant pneumonias, sexually transmitted infections (STIs), and skin and soft tissue infections (MRSA), also spread in the community.



NON-DRUG RESISTANCE VS. DRUG RESISTANCE...

- This diagram shows the difference between non-resistant bacteria and drug resistant bacteria
- Non-resistant bacteria multiply, and upon drug treatment, the bacteria die
- Drug resistant bacteria multiply as well, but upon drug treatment, the bacteria continue to spread



Source: NIH

HOW DRUG RESISTANCE OCCURS...

■ Selective Pressure :

- Microbes are either killed or, if they carry resistance genes, survive. These survivors will replicate, and their progeny will quickly become the dominant type throughout the microbial population

■ Mutation:

- During replication, mutations arise and some of these mutations may help an individual microbe survive exposure to an antimicrobial

■ Gene Transfer:

- Microbes also may get genes from each other, including genes that make the microbe drug resistant



Mutation

WHAT CAUSES DRUG RESISTANT INFECTIONS?

- The improper use and abuse of antibiotics has led to the development of antibiotic resistance
- The most common misuse and abuse of antibiotics are:
 - Health Care Providers prescribing antibiotics for viral infections
 - Not finishing the full dosage of an antibiotic
 - When an antibiotic prescription is not finished (even leaving one or two pills), it leaves some bacteria alive and "resistant" to future antibiotic treatment



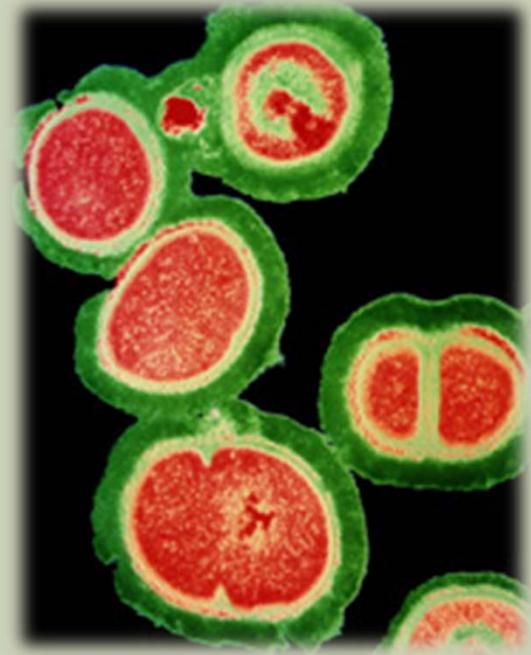
WHAT CAUSES DRUG RESISTANT INFECTIONS?

- Many individuals either expect or ask their health care provider to prescribe antibiotics when they feel sick or have a common cold
- Patients should understand, though, that antibiotics are intended to treat bacterial infections, not viral infections
- Many times a common cold is a viral infection and antibiotics should not be taken if you have a cold or the flu



SOME EXAMPLES OF DRUG RESISTANT BACTERIA...

- [Anthrax](#)
- [Carbapenem-resistant Enterobacteriaceae](#)
- [E. Coli](#)
- [Gonorrhea](#)
- [Group B Strep](#)
- [MRSA](#)
- [Neisseria meningitidis](#)
- [Shigella](#)
- [TB](#)
- [Vancomycine-resistant Enterococci](#)



MRSA

Source: DisvoerR8.com

To learn about these drug resistance bacteria, click on their name

THE COST OF DRUG RESISTANCE...

- According to the Centers for Disease Control and Prevention (April 2011), antibiotic resistance in the United States costs an estimated \$20 billion a year in excess health care costs, \$35 million in other societal costs and more than 8 million additional days that people spend in the hospital (NIH)
- *Antibiotic resistance is one of the world's most pressing public health threats (CDC)*



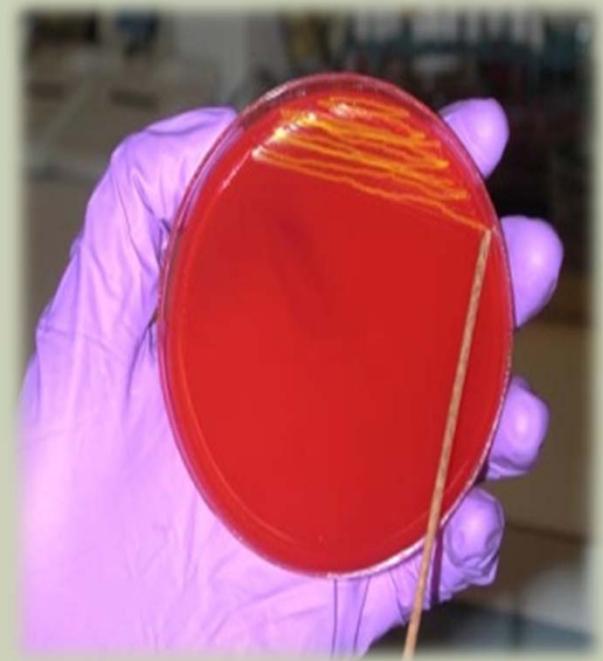
EFFECTS OF DRUG RESISTANT DISEASES...

- People infected with drug-resistant organisms are more likely to have longer and more expensive hospital stays, and may be more likely to die as a result of the infection
- When the drug of choice for treating their infection doesn't work, they require treatment with second- or third-choice drugs that may be less effective, more toxic, and more expensive
- This means that patients with an antibiotic-resistant infection may suffer more and pay more for treatment.



DIAGNOSIS OF BACTERIAL INFECTIONS...

- Diagnostic tests are designed to determine which microbe is causing infection and to which antibiotic the bacteria might be resistant
- This information would be used by a healthcare provider to choose an appropriate antimicrobial treatment
- However, current diagnostic tests often take a few days or weeks to give results
- This is because many of today's tests require the microbe to grow over a period of time before it can be identified.



LAB RESULT...

SOURCE: **URINE**
ANTIBIOTICS AT COLL.:

COLLECTED: 02/01/13 09:00
RECEIVED : 02/01/13 09:12

CLUTURE URINE
02/03/13 >100,000 CFU/ML ESCHERICHIA COLI
ORGANISM 1 ESCHERICHIA COLI

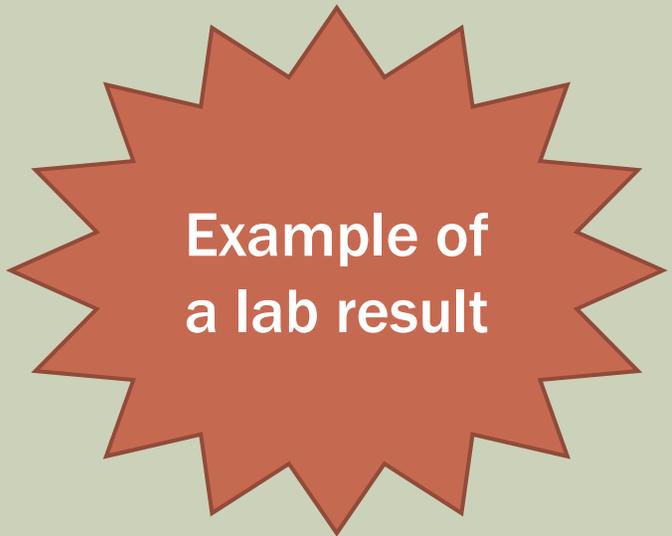
FINAL 02/03/13 10:14

| ORGANISM | E. coli | |
|---------------------------|-----------------|----------|
| ANTIBIOTICS | MIC | INTERP |
| Amikacine | <= 8 | S |
| Ampicillin | >16 | R |
| Ampicillin/sulbactam | 16/8 | I |
| Azteronam | <-2 | S |
| Cefazolin | <-2 | S |
| Cefepime | <-1 | S |
| Cofoxitin | <-4 | S |
| Ceftazidime | <=0.5 | S |
| Cefuroxime | <-4 | S |
| Ciprofloxacin | <=0.5 | S |
| Gentamicin | >8 | R |
| Imipenem | <=1 | S |
| Levofloxacin | <=1 | S |
| Meropenem | <=1 | S |
| Nitrofurantoin | 32 | S |
| Piperacillin/Lazobactam | <=2/4 | S |
| Tetracycline | <=2 | S |
| Tobramycin | <=2 | S |
| Trimethoprim/Sulfa | >2/38 | R |

S=SUSCEPTIBLE

I=INTERMEDIATE

R=RESISTANT



Example of
a lab result

Courtesy of Sydney Ehmke, MSN,MBA,FNP
Riverview Hospital Community Clinic

WHAT QUESTIONS SHOULD I ASK MY HEALTH CARE PROVIDER?

- Why do I need an antibiotic
- What is this particular antibiotic supposed to do
- Is this drug likely to cause any side effects
- Is there anything I can do to prevent these side effects
- Should I take the drug at a specific time



WHAT QUESTIONS SHOULD I ASK MY HEALTH CARE PROVIDER?

- With or without food
- Does this drug interfere with the effectiveness of other medication? (i.e., birth control pills)
- Do I need to avoid alcohol or other foods



HOW TO PREVENT DRUG RESISTANCE...

- Both health care providers and patients have a role to play in decreasing the misuse of antibiotics
- Antibiotics should only be prescribed when a test (such as a throat culture) shows that there is a bacterial infection present
- Antibiotics are not effective in fighting a viral infection
- Patients should not demand that their health care provider prescribe antibiotics when they are not needed



Throat culture

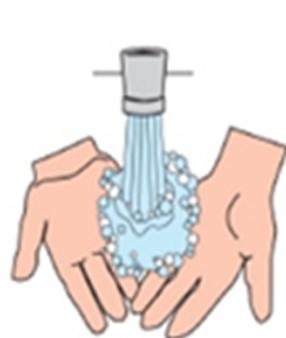
HOW TO PREVENT DRUG RESISTANCE...

- Washing your hands with soap and water is the best way to prevent the spread of bacterial and viral diseases
- If soap and water are not available, you can use alcohol based hand antiseptic that contains 60% alcohol
- You need to wash your hands with soap and water as soon as possible
- Hand antiseptics do not kill all types of bacteria or virus
- Hand antiseptics are not effective when hands are visibly dirty



HANDWASHING...

HANDWASHING



1. Wet hands with hot water (100°F-110°F)



2. Use soap



3. Lather, rub Sing Happy Birthday twice (15-20 seconds)



4. Rinse



5. Towel or air dry hands



6. Turn off water with towel or sleeve

Source: City of Ottawa

**Hamilton County Health Department
Division of Health Education**

HAND ANTISEPTIC...

HAND ANTISEPTIC



1. Place a drop of alcohol-based hand sanitizer, the size of a dime in your palm.



2. Rub hands together; palm to palm.



3. Rub back of each hand with palm and interlaced fingers of the other hand



4. Rub around each thumb clasped in the opposite hand.



5. Rub fingertips of each hand backward and forward in the opposite hand.



6. Keep rubbing until your hands are dry. Paper towels are not needed

Source: City of Ottawa

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THINGS TO DO AND NOT DO...

- **DO NOT** demand antibiotics from your healthcare provider
- Finish all your antibiotics, even if you are feeling better
- Take the antibiotic as it is prescribed
- Only take antibiotics that were prescribed to you
- **DO NOT** give your antibiotics to anyone else
- Keep a list of antibiotics, so you know which ones work and which ones do not



TREATMENT...

- As healthcare providers often cannot wait several days for that information before treating their patient, they may reach for a broad-acting drug they hope will kill whatever is infecting the patient
- Unfortunately, the practice of using broad-spectrum drugs before the specific microbe is identified can accelerate the emergence of drug-resistant strains



HOW TO PREVENT DRUG RESISTANCE...

- Taking antibiotics when you have a viral infection not only wastes your time and money, but also contributes to increasing antibiotic resistance
- Patients should ask their healthcare provider if they have a viral or bacterial infection and which tests have been done to prove this
- Healthcare providers too, must change their prescribing practices and only prescribe antibiotics for their patients when a bacterial infection is present



THINGS TO THINK ABOUT..

- **Understand when antibiotics should be used:**
 - Don't expect to take antibiotics every time you're sick
 - Antibiotics are effective in treating most bacterial infections, but they're not useful against viral infections, such as colds, acute bronchitis or the flu
 - Even some common bacterial ailments, such as mild ear infections, don't benefit much from antibiotics
- **Don't pressure your health care provider for antibiotics if you have a viral illness:**
 - Instead, talk with your healthcare provider about ways to relieve your symptoms



THINGS TO THINK ABOUT..

- **Take antibiotics exactly as prescribed:**
 - Follow your healthcare provider's instructions when taking medication
 - Don't stop treatment a few days early because you're feeling better
 - Taking the full course of antibiotics is the only way to kill all of the harmful bacteria
 - A shortened course of antibiotics, on the other hand, often wipes out only the most vulnerable bacteria while allowing relatively resistant bacteria to survive
- **If you have questions about your antibiotics:**
 - Call your healthcare provider
 - Call your pharmacy



SOURCE...

- American Academy of Family Physicians
- American Academy of Pediatrics
- Alliance For The Prudent Use Of Antibiotics
- Centers For Disease Control and Prevention
- Mayo Clinic
- Medicine.Net
- National Institute of Health

