



“Community and Provider Education”

Preserving Our Antibiotic Lifeline

September 9, 2011

What is the MARR Coalition?

- The Michigan Antibiotic Resistance Reduction (MARR) Coalition is a multi-stake-holder, non-profit organization
- Supported by an annual, competitive grant from the CDC
- MARR's Goals are to:
 - Encourage appropriate use of antimicrobial agents
 - Reduce antimicrobial resistance rates through diverse collaboration
 - Promote appropriate use of antibiotics through educational programs and interventions

REQUIREMENTS OF THE CDC “GET SMART” GRANT

- Assist state and local agencies in health communication efforts and interventions to promote appropriate antibiotic use and to prevent the spread of antimicrobial resistance
- Focus is on the community and outpatient practice settings
- Grant activities can not be “research” in nature
- Specific outcomes targeted at changing knowledge, attitudes and practice behaviors
- Grant projects must have an evaluation component

Community Education

Let's make
it fun!



- “Antibiotics and You” presentation for elementary students and adults
- High School Biology Curriculum Project
- Consumer education materials (“Antibiotics: What You Should Know” and “MRSA”, posters, fact sheets, FAQs)
- MARR website: www.reducemisuse.org
- Health fairs
- “GET SMART” Antibiotics Awareness Week
- Legislative education
- Community speaking engagements

HEALTHCARE PROVIDER EDUCATION

- MARR/Wayne State University CME web-cast for physicians, nurses, physician assistants
- Long-Term Care Tool Kit
- Conference presentation for CME credits
- Priority Health “Reduce the Use” Project
- Health Plus and Genesee County ISD
- Blue Care Network and BCBSM Projects
- “Train the Trainer” with College of Pharmacy students and other professionals

How Does MARR Measure Impact?

- Annual report from three pharmacy schools and others
- Attendance at health fairs and other community engagements
- Website hits, educational materials distributed
- Quarterly reports
- Survey results from projects
- Annual grant application reports results from the previous year and measurements for new year

Multiple Drug Resistant Organisms:

MARR Involvement in Training and Surveillance

- MRSA brochure developed by MARR and MDCH
- Partner on the MDCH HAI Workgroup
- Supports increased voluntary reporting by hospitals to NHSN
- Supports adequate funding for MDCH lab
- Collaborates with organizations like MSIPC, IDSA, MHA and Keystone
- MARR reviews data from the same sources

Getting the Message Out to the Community: General Public and Professionals

- MARR website puts out newest information from the CDC
- Sharing executive summaries of select AR reports
- Development of brochures, public and physician education tools
- Presentations
- Organizational collaborations
- Working with other states to identify most effective techniques to educate the public and professional communities



Engaging the General Public

- Most people have a limited understanding about antibiotic resistance
- Physicians do not have the time to discuss in detail
- Many people have heard about antibiotic resistance but don't know how it impacts them
- If people knew - would it change their behaviors?

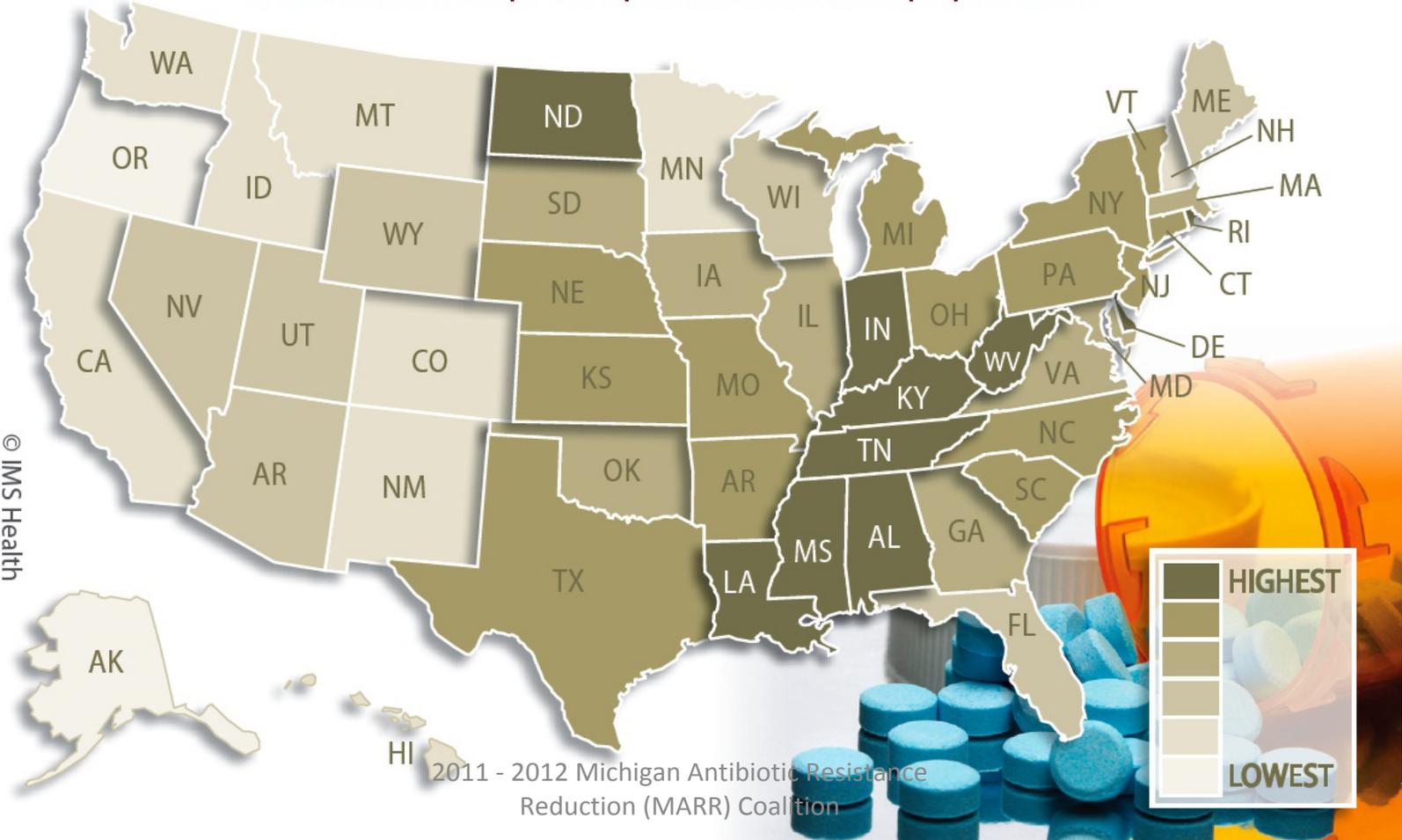


National Antibiotic Prescribing

CDC Abstract, 10/22/2010

Antibiotic prescriptions per capita in each state across the U.S.A.

Based on 2009 prescriptions and 2008 population



National Geographical Results

2009 CDC Abstract 10/22/2010

- Highest antibiotic use rate was in West Virginia
- Alaska had the lowest rate
- Generally, Southern states had higher prescription rates than the West
- Prescribing rates have marked geographical variability
- Macrolides were the most commonly prescribed class of antibiotics

Commitment, Leadership, Knowledge and Innovation

Promote the MARR Message

Recent project collaborators:

- University of Michigan School of Pharmacy
 - Ferris State University School of Pharmacy
 - Wayne State University School of Pharmacy
 - Health Plus
 - Priority Health
 - Blue Care Network
 - Blue Cross Blue Shield of Michigan
 - Michigan Health and Hospital Association
 - Michigan Department of Education
 - Michigan Department of Community Health
 - Oregon AWARE Program
 - Merck
 - Reckitt Benckiser
 - PEW Charitable Trusts
 - Michigan State Medical Society
 - Infectious Disease Society of America
 - Michigan Public Health Institute
- 2011 - 2012 Michigan Antibiotic Resistance Reduction (MARR) Coalition

HIGH SCHOOL CURRICULUM PROJECT

- Implementation scheduled for January 2012
- Designed for 9th and 10th grade biology/health class
- Two 45 – 60 minute lesson
- Collaboratively developed between MARR and the Oregon AWARE program
- Designed to meet national science competency standards
- Developed and promoted by MARR with help from the Michigan Department of Education, Michigan's 32 Math and Science Centers, and the Michigan Department of Community Health

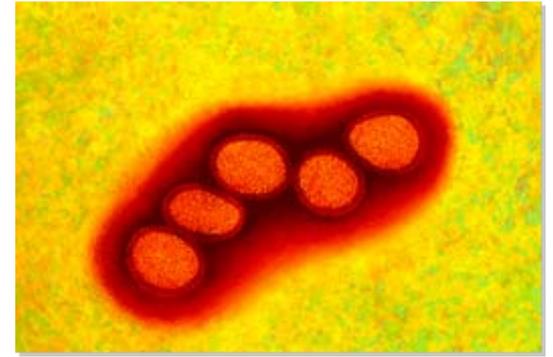
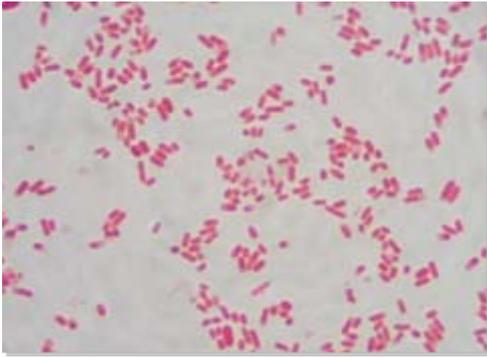


High School Curriculum Project

(cont.)

- Today you will hear a subset of what has currently been developed for high school biology students, minus some of the graphics
- Presentation is designed for high school and adult audiences to educate them about:
 - the evolution of bacteria,
 - development of antibiotics,
 - rise of selective pressure (resistance),
 - antibiotic resistance (including multiple drug resistant organisms)
 - how we can help to preserve our antibiotic lifeline





BACTERIA AND VIRUSES

ANTIBIOTICS

AND

BACTERIAL RESISTANCE TO
ANTIBIOTICS

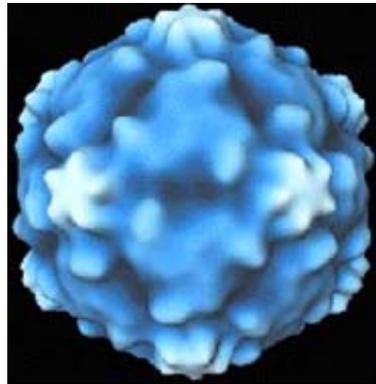
What Are Microbes?

- Microscopic living organisms
- Four major types of microbes:
 1. Bacteria
 2. Viruses
 3. Parasites
 4. Fungi
- **We will focus on bacteria and provide some information about viruses.**

Two Major Classes of Germs

Viruses

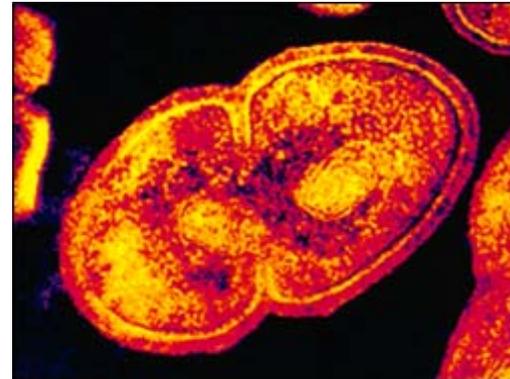
- Genetic material (DNA or RNA) in a protective coat
- Attach themselves to a host cell to reproduce inside the cell



Rhinovirus (cold)

Bacteria

- Independent cell
- Able to live and reproduce outside human or animal cell



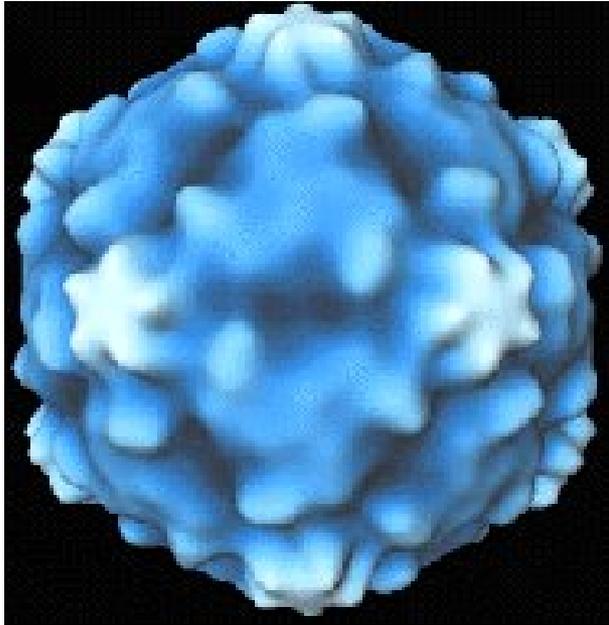
Streptococcus pneumoniae

What Are Viruses?

- The smallest infectious particles with a core of genetic material (DNA or RNA)
- Surrounded by:
 - a protein,
 - a lipid (fat), or
 - a combination of a lipid and a sugar-protein coat

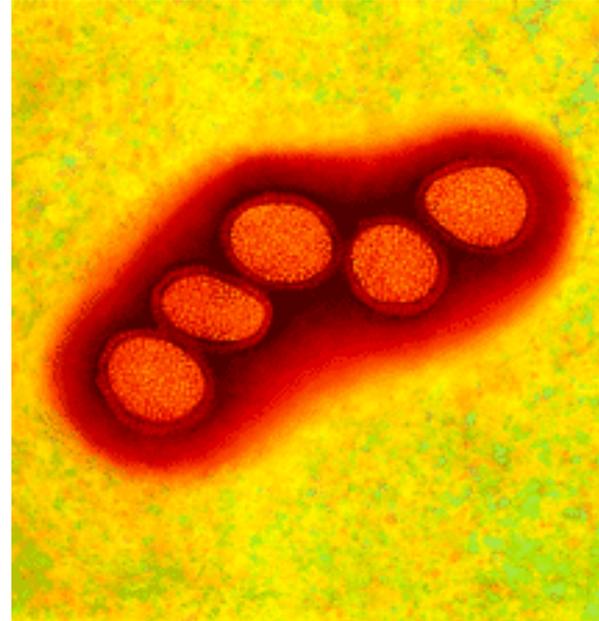
What Some Viruses Look Like

(not to scale)



Rhinovirus

- Common cold

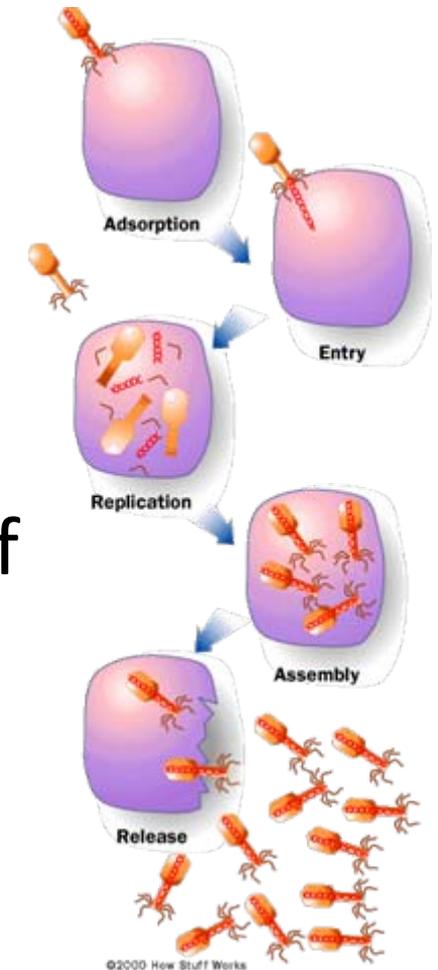


Influenza Virus

- Flu

Viruses Invade Host Cells

- Viruses lack some of the machinery to grow and reproduce by themselves
- A virus invades a live host cell inside your body and starts replicating itself
- The host cell releases the copied viruses
- Each released virus will look for a new live host cell to invade and repeat the process



Virus infecting a cell

The Host Defends Itself

- The Immune System

- Detects the virus

- Produces specific antibodies to inactivate the virus

- Sends white blood cells to fight and destroy the virus



What Are Some Diseases Caused by Viruses?

- Common cold
- Influenza
- Measles, chickenpox, smallpox
- Herpes (e.g., cold sores)
- HIV
- Human Papillomavirus (causes cervical cancer)
- Hepatitis
- Rabies

How Do We Contract Viruses?

- Simple contact with an infected person (shaking hands [direct contact] or sneezing [respiratory or airborne spread])
- Exchange of bodily fluids such as saliva
- Sexual contact (e.g., HIV)
- Contaminated food or water
- Insects (e.g., mosquitoes)
- Infected animals (e.g., animals with rabies)

Other Facts About Viruses

- Some viral infections can be prevented by vaccines (e.g., influenza, HPV, hepatitis B, measles and mumps)
- Treatment for the common cold is directed toward relief of symptoms with over-the-counter (OTC) medicines while the body's immune system is fighting the virus
- Antiviral medications are available for certain viruses (e.g., neuraminidase inhibitors for flu)

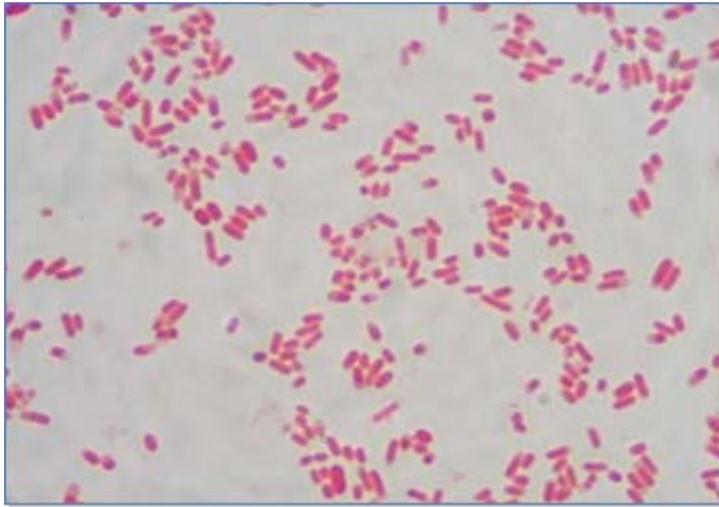


What Are Bacteria?

- Single-celled microscopic organisms
- Larger than viruses but smaller than human cells
 - Majority play a positive role in nature:
 - Aid in digestion
 - Digest sewage into simple chemicals
 - Extract nitrogen from air and make it available to plants for protein production
 - Some are harmful (pathogenic):
 - Damage tissues or produce toxins that cause disease

What Some Bacteria Look Like

(not to scale)



Escherichia coli (*E coli*)

- Urinary Tract Infection



Streptococcus pyogenes

(Group A *Streptococcus*)

- Strep throat (pharyngitis),
skin infections

Natural Habitats of Bacteria

Environment

- Soil, plants, water

Animals and Humans

- Skin
- Upper airway and mouth
- Gastrointestinal tract
- Vagina



Most Bacteria Are Harmless And Even Beneficial

- Soil, water, plants

- Recycle organic matter and wastes

- Animals

- Aid in digestion of cellulose in stomachs of cows



- Humans

- Occupy (colonize) sites that might otherwise be invaded by harmful (pathogenic) bacteria
- Aid in digestion

Bacteria May Inhabit Other Sites

- May survive for various time periods on other surfaces that have had contact with bacteria
 - toilets
 - sinks
 - cell phone
 - desks
 - remote controls
 - food

Colonization vs. Infection

- Colonization: The presence of bacteria in or on your body without causing any symptoms of infection
- Infection: Bacteria invades and damages tissue, or produces a toxin that damages tissue

Identification of Bacteria

Generally identified by:

1. shape when viewed under the microscope
2. procedure called Gram stain; which is positive or negative, depending on type of cell wall
3. whether it requires oxygen to grow
4. nutrients they can use to grow
5. identification of sequences of proteins made by the bacteria, or sequences of the bacteria's DNA or RNA

Host Defenses Against Pathogenic Bacteria

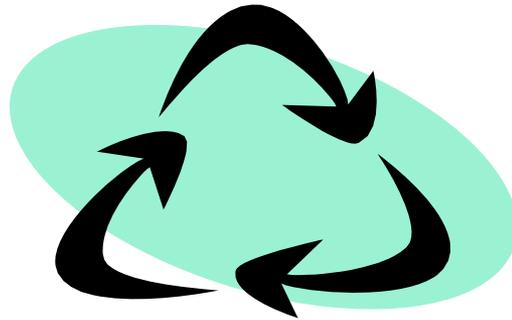
- First line of defense is a physical barrier
 - Intact skin
 - Lining of upper airway, gastrointestinal (GI) tract, vagina
 - Stomach acid
 - Frequent flushing out of eyes by tears, or of bladder by urine
 - Mucus in the lungs and coughing

Host Defenses Against Pathogenic Bacteria (cont.)

- Immune System
 - Detects bacteria and their products
 - Produces specific antibodies (proteins)
- Antibodies work at the infection site to:
 - Bind and inactivate the bacteria
 - Cause inflammation and increase blood flow
 - Recruit white blood cells to ingest and kill the bacteria

How Does Bacteria Damage the Host Cell?

How Bacteria Cause Infection



- Pathogenic bacteria have certain disease-producing features
- These features are called “virulence factors”

Bacterial Offense

“Virulence Factors”

- Allows bacteria to attach to host cells
- Produces toxic compounds that damage host cells or surround tissue
- Produces proteins that either disrupt the host cell or stimulate uptake into the host cell, allowing them to penetrate deeper into different parts of the body
- Produces factors that inhibit host’s immune response

The Battle Between Bacteria and Host

- Pathogenic (disease-causing) bacteria attack healthy host cells
- Three potential outcomes:
 1. host cell wins, bacteria are removed, cell recovers, **or**
 2. bacteria win and kill the host cell, **or**
 3. bacteria and host cell live together



What is an Antibiotic?

- A chemical that kills bacteria or stops them from growing
- Antibiotics work **only against bacteria**, not viruses

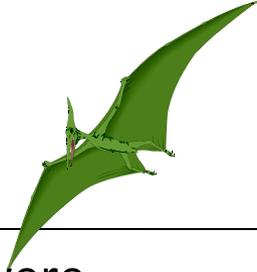




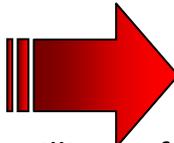
Timeline of Antibiotics and Development of Resistance

Antibiotic Timeline

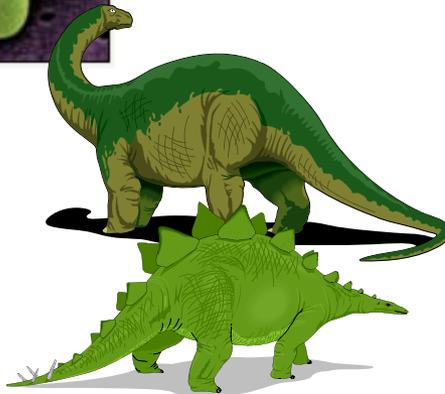
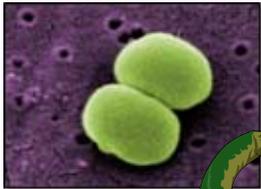
Way B.C.



Bacteria were present before the dinosaurs



Millions of years later



1940s

The first antibiotics are mass produced for humans and work well



1950s

Antibiotic resistance begins as soon as the first antibiotics are used



1990s

Current teenagers are born!



Today
Some antibiotics no longer work and few new ones are in the pipeline

2030

Will we have antibiotics that work?





Key Knowledge About Antibiotics

- The first antibiotics were made from products of soil microbes (fungi and bacteria)
- These microbes were fighting with other microbes for space to live and grow in the soil
- Chemists developed the first mass produced antibiotics in the 1940s
- These antibiotics did not maintain their effectiveness very long because some mutated bacteria became resistant and could survive and proliferate



Key Knowledge About Antibiotics

- Chemists then made new, more sophisticated antibiotics
- In a short period of time, bacteria developed resistance to these new antibiotics
- Today some newer antibiotics are synthetic, designed to jam and kill the mutating bacteria
- Bacteria continue to mutate and survive new antibiotics



Key Concepts to Remember About Antibiotics

- A newly developed antibiotic is most effective when it is first released for human treatment since later use will inevitably select resistant bacteria
- Today some antibiotics no longer work effectively against certain bacteria
- Over time, even fewer antibiotics will be effective, unless newer ones can be developed to replace them
- The development of new antibiotics has slowed, primarily due to development cost and lower financial incentive, compared with drugs that may be taken on a daily basis

How Do Antibiotics Work?

- Antibiotics disrupt a specific function of a bacterium preventing its growth and replication by:
 - interfering with DNA or RNA replication
 - interfering with the production of the bacterial cell wall
 - preventing the production of proteins necessary for growth and replication

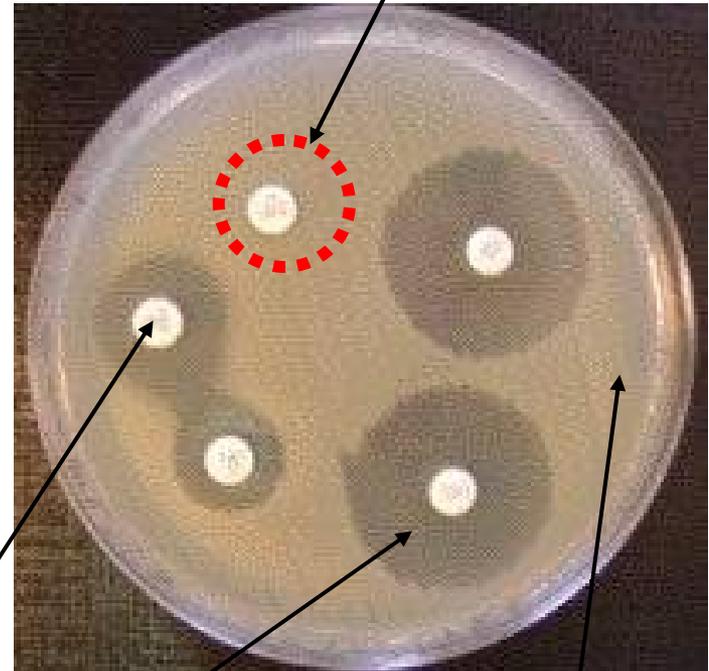
How Is An Antibiotic Chosen For Treatment?

- Care provider takes a history and does a physical exam to determine if there is a bacterial infection and the likely site of infection and possible bacteria
- Collects a specimen for lab testing, whenever possible, to identify the specific bacterium
- The lab grows bacterium and determines its susceptibility to a range of different antibiotics

Choosing the Right Antibiotic For the Bacterial Infection

- Bacteria grown in the lab are swabbed on the surface of an agar culture plate
- Filter paper disks containing different antibiotics are placed on the surface of the agar plate
- The agar plate is incubated at body temperature over night
- An effective antibiotic is indicated by a “wet zone” on the agar plate showing the bacterium did not grow *

*Bacteria are resistant to this antibiotic.



Antibiotic

Bacteria from tissue or fluid sample

The “wet zones” around various antibiotics on this agar plate mean that this bacterium is sensitive to those various antibiotics. The amount of sensitivity is shown by the size of “wet zone”.

Narrow and Broad Spectrum Antibiotics

- Narrow-spectrum antibiotics are targeted to a limited group of bacterial species
- Broad-spectrum antibiotics are effective against a wide range of bacterial species
- A narrow-spectrum antibiotic should be used to target the **specific** bacterial infection, preserving the good bacteria and avoiding selection of resistance in these bacteria that might later cause infection
- A broad-spectrum antibiotic is used when a sensitivity test has not been done and you do not know the infectious bacterium and its susceptibility pattern

How Does Resistance Develop?

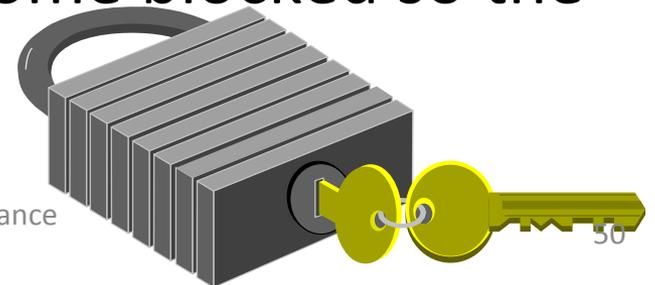
- I. Mutations in resistant genes in bacteria
- II. Transfer of genetic material from resistant bacteria to susceptible bacteria
- III. Selective pressure (evolution)

I. Bacteria Are Clever – Resistance Against Antibiotics

- Mutations in bacterial genes can:
 - Make the bacterial cell wall less permeable, preventing the antibiotic from entering the bacterial cell
 - Produce enzymes that inactivate the antibiotic
 - Pump the drug out of the cell before it gets a chance to work
 - Alter the target site where the drug usually binds to the bacteria, so it can't bind anymore

Bacterial Lock and Antibiotic Key

- **If you think of bacteria as a lock and antibiotics as a key – four things can occur:**
 - The antibiotic key can unlock the bacteria and kill it
 - The antibiotic key can become damaged so it can not open the bacterial lock
 - The bacterial lock can make slight changes so the key (antibiotic) no longer fits in the lock
 - The bacterial keyhole can become blocked so the antibiotic can not enter



II. Transfer of Genetic Material Between Bacteria

- Bacteria can exchange DNA or RNA between bacteria of the same or different species
- Example:
 - Child X with strep throat infection resistant to an antibiotic coughs on child Y, who then becomes infected with resistant strep
 - Sensitive bacteria colonizing child Y's throat exchange genes with resistant strep, acquiring mutation making them resistant to antibiotics

III. Selective pressure:

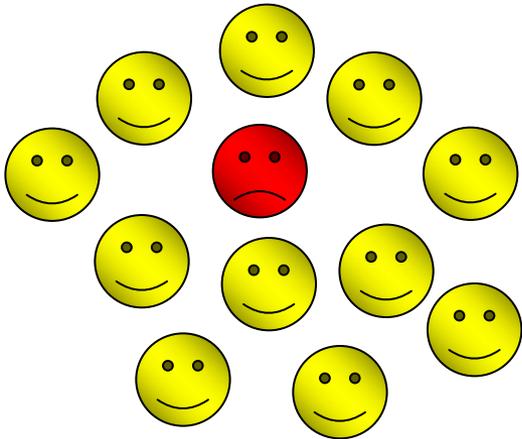
Environment that enhances ability of an organism to become resistant by mutation or acquisition of new DNA

Mechanism

- Patient non-compliance (only taking for a few days or skipping doses)
- Inadequate dosing (not high enough dose, or doses spaced too far apart)
- Misuse of antibiotics
 - Overuse (prescribing when not needed)
 - Unnecessary use of broad-spectrum antibiotic (exposing patient to drug that can affect bugs in GI tract in addition to target bacteria in throat, for example)

Selection for Resistance

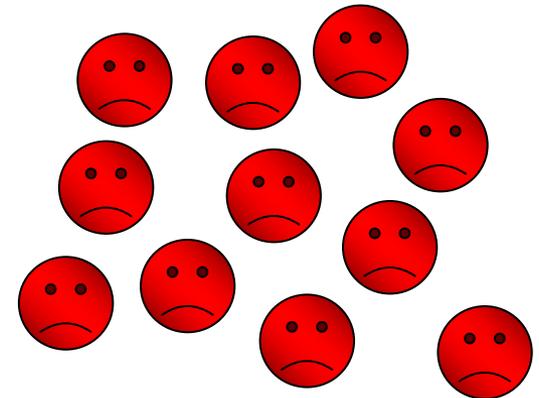
Sensitive and resistant bacteria live together.

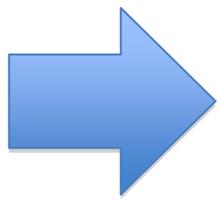


Antibiotics kill sensitive bacteria.



The resistant bacteria are left to multiply.





Important Things to Remember About Antibiotics



- Antibiotics kill bacteria, not viruses.
- Taking an antibiotic unnecessarily for colds and flu can select bacteria in the body that are resistant to the antibiotic.
- Never save or share your antibiotics.
- Take your antibiotics as prescribed by your care provider.

Why Should We Be Concerned About Antibiotic Resistance?

- Antibiotic resistance is a serious **global** problem
- Resistant infections are difficult to treat the bacteria may be resistant to multiple types of antibiotics
- Resistance limits the range of effective antibiotics, sometimes only leaving antibiotics that are expensive, inconvenient to use, or even dangerous (toxic)



Why Should We Be Concerned About Antibiotic Resistance? (cont.)

- It takes 10 years to develop a new antibiotic and over \$1B to fund the development
- Newer antibiotics may have more side-effects, be more expensive and/or less effective than drugs previously developed but now compromised by resistance
- Antibiotics are generally less profitable to drug manufacturers, so there are fewer financial incentives to develop new antibiotics



Additional Environmental Concerns

- Antibiotics are being used to treat meat and poultry to **prevent** infections rather than treat them, and to promote faster growth; this can lead to selection of antibiotic resistant bacteria which can get into humans, either from close contact or consumption of infected meat or dairy products
- Improper disposal of old or unused antibiotics can pollute the water supply, exposing the general public to low levels of antibiotics



Preventing Bacterial Infection is the Best Medicine!

- Wash your hands properly
 - Before eating
 - After using the bathroom
 - After a sneeze or cough
- Cover coughs and sneezes
- Help your immune system by:
 - Eating healthy foods
 - Exercising regularly
 - Getting plenty of sleep every night
- **NEVER** take an antibiotic for a viral infection, like a cold or flu



What Else Can You Do



- If you are prescribed antibiotics, take all of the medication as prescribed by your care provider
- Do not stop taking an antibiotic before the end of the treatment course just because you start to feel better; residual bacteria may multiply, causing recurrence of symptoms that may require re-treatment increasing the likelihood of selecting resistant cells
- Never share or save antibiotics
- **Spread the word, not the resistance**

Remember.....



- Every time someone takes an antibiotic, resistant bacteria may become selected and multiply
- Resistant bacteria may then spread to others, compromising the effectiveness of treatment for future infections

Protect Our Antibiotic Lifeline

- Encourage proper vaccinations for infants, children, adults and travelers
- Educate about the proper use of antibiotics
- Promote proper hand hygiene
- Use targeted antibiotics, rather than broad-spectrum whenever possible
- Promote consistent data collection and reporting
- Support research for new antimicrobial development
- Educate as many people as possible



You Can Make a Difference



MARR

Michigan Antibiotic Resistance Reduction Coalition



Thank you!

Learn more at : www.reducemisuse.org

Jane L. Finn, Executive Director