

Antibiotic Resistance

Occurs when a microorganism fails to respond to a drug that it was previously susceptible to.

Not limited to hospitals, also seen in

- Nursing homes/extended care/rehab
- Community

Antibiotic Resistance: A Growing Concern

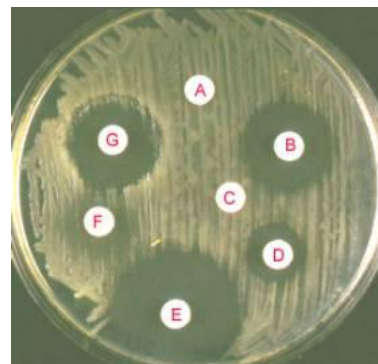
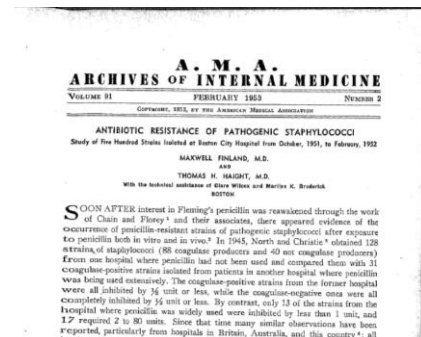
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Why do we care about antibiotic resistance?

Antibiotic resistance leads to

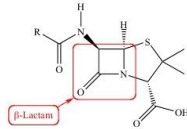
- Treatment failure
 - Poor outcomes
 - Increased mortality
- Increased need for combination therapy
- Increased cost of treatment

Antibiotic resistance is not new



Drug inactivation

- Penicillinase was 1st recognized in *Staph aureus* soon after the introduction of Penicillin.
- Beta-lactamases – an enzyme produced by the bacteria that breaks the beta-lactam ring of the antibiotic.



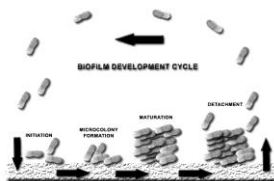
Alter the targeted metabolic pathway

Turn the pump on!

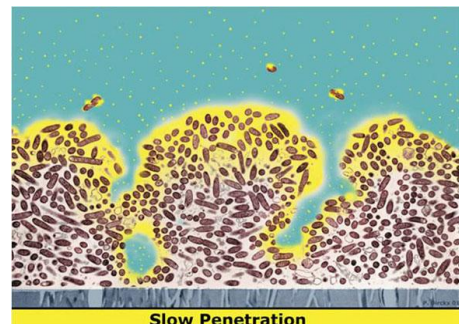
- Pumps are natural mechanisms in the cell
 - Tetracycline resistance is frequently a result of bacteria pumping the drug out.

Biofilms

- Biofilm is a complex matrix of organisms and extracellular polysaccharides (slime).
- Develop on hardware & invasive devices
- Biofilms result in
 - Poor drug penetrator
 - Ability to evade host defenses



Antibiotic has difficulty reaching all the bacterial cells in a biofilm



Intrinsic (Naturally occurring)Resistance

- Does not require new genetic information
- May have been turned on in the presence of the antibiotic
 - pump mechanisms
 - Increase the production of the target

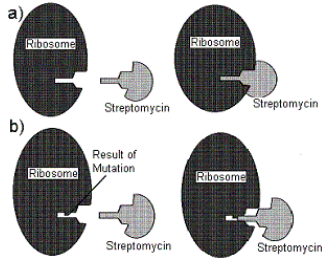
Acquired resistance

- Acquire new genetic material by
 - Mutation
 - Conjugation
 - plasmids
 - Transduction
 - Virus brings in
 - The DNA junk yard

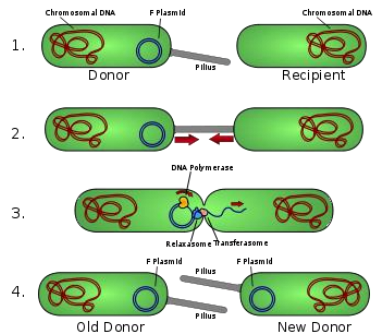


Mutation

- Spontaneous change in genetic material



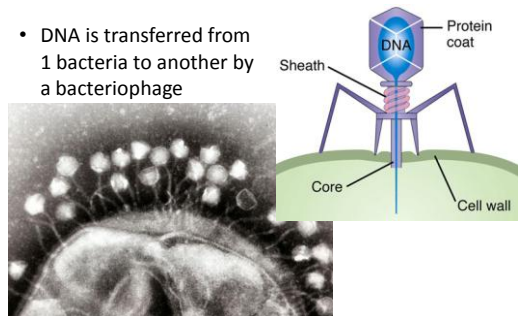
Conjugation - Pass the Plasmid!!



It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.

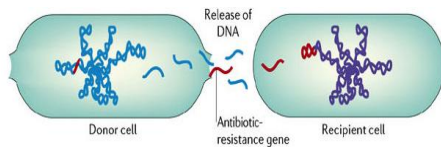
Transduction

- DNA is transferred from 1 bacteria to another by a bacteriophage

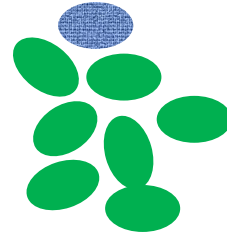


DNA Junk Yard

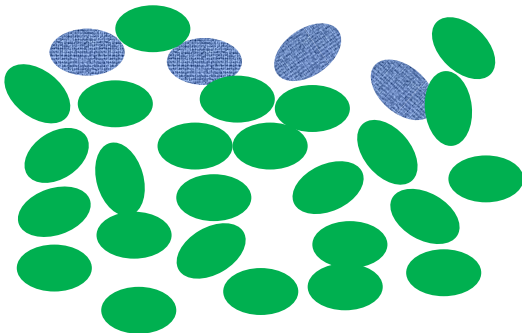
- Bacteria pick up genetic material from cells that have died.



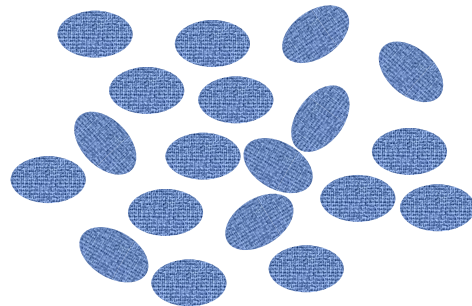
Selection of resistant organism



No antibiotics – all reproduce



Antibiotic introduced



ESBL

Extended Spectrum Beta Lactamase

- Resistant to the 3rd & 4th generation cephalosporin
- Plasmid mediated
- >250 beta lactamases have been identified
- Seeing it in *E. coli* & *Klebsiella* and other members of the Enterobacteriaceae
- Risk factors
 - Prolonged hospital stay with ICU stay
 - Invasive medical devices
 - Previous antibiotic use

CRE

Carbapenem Resistant Enterobacteriaceae

- Rapidly emerging public health problem
- Plasmid mediated
- Several different mechanisms
 - KPC, VIM, NDM-1
- May require special testing to detect
- Resistant to many antibiotics



They're not passengers arriving from a crash. They're part of our medical tourism travel package.

IDSA's bad bug list

ESKAPE

- *Enterococcus faecium*
- *Staphylococcus aureus*
- *Klebsiella pneumoniae*
- *Acinetobacter baumannii*
- *Pseudomonas aeruginosa*
- *Enterobacter spp.*

ESCAPE

- *Enterococcus faecium*
- *Staphylococcus aureus*
- *Clostridium difficile*
- *Acinetobacter baumannii*
- *Pseudomonas aeruginosa*
- *Enterobacteriaceae*

NDM-1

New Dehli metallo-beta-lactamase-1

- Resistant to most currently available antibiotics
- Plasmid mediated
- Found in *E. coli* & *Klebsiella pneumoniae*
- Felt to have originated in India
 - Overuse of antibiotics, poor hygiene & sanitation, over crowding
 - Medical tourism

VISA VRSA

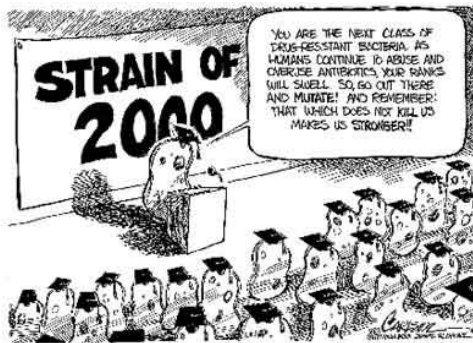
Vancomycin intermediate/resistant SA

- Vancomycin has become the main treatment for *Staph aureus* infections
- VISA – identified in 1996
- VRSA – identified in 2002



How did we get into this mess?

- Overuse of antibiotics
 - In humans
 - Patients who demand an antibiotic
 - Physicians who prescribe to keep patients happy or fear of negligence
 - Non-human uses
 - animal feed
- Decrease in research & development of new antibiotics
 - Pharmaceutical companies won't invest
 - Regulatory agencies make it difficult to new antibiotics approved



Antibiotic Stewardship

Goals of antibiotic stewardship

- Optimize clinical outcomes
- Minimize unintended consequences
 - Toxicity
 - Emergence of resistance
 - Selection of pathogens (C.diff)
- Reduce cost

3 steps towards antibiotic stewardship

1. All antibiotic orders need dose, DURATION, and REASON
2. Whenever possible, GET A CULTURE
3. ANTIBIOTIC TIME OUT when culture is back
 - a. Is an infection unlikely?
 - b. Is this a resistant organism?
 - c. Can a narrower spectrum drug be used?



Education for patients

- Give it a name Bronchitis caused by a virus
 - Explain why antibiotics are not needed
- Provide specific instructions for symptom relief
- Information about what to expect
- Information about when to call back

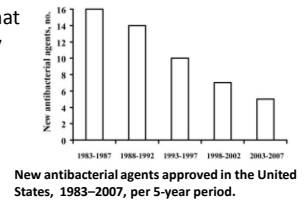


Infection Prevention

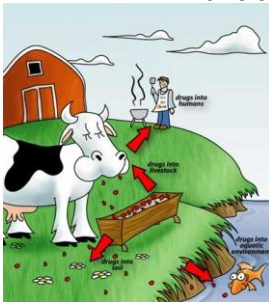
- HAND HYGIENE
- Standard Precautions
 - appropriate use of Expanded Precautions
- Reduce the patients risk of developing an infection
 - Minimize use of invasive devices
 - Minimize use of antibiotics
 - Skin care

Antibiotic Development

- Encourage research and development
- Look at regulations that are getting in the way



Examine the non-human use of antibiotics



- Up to 70% of the antibiotics used in the USA are used in feed for animals (cows, pigs, chickens and other animals) to promote growth & prevent disease.

Antibiotics in the environment



Effective antibiotics are becoming a scarce resource

Use them wisely!