BACTERIA, ANTIBIOTICS AND ANTIBIOTIC RESISTANCE

Photo: *Mycobacterium tuberculosis* bacteria, NIAID (from flickr).[1]

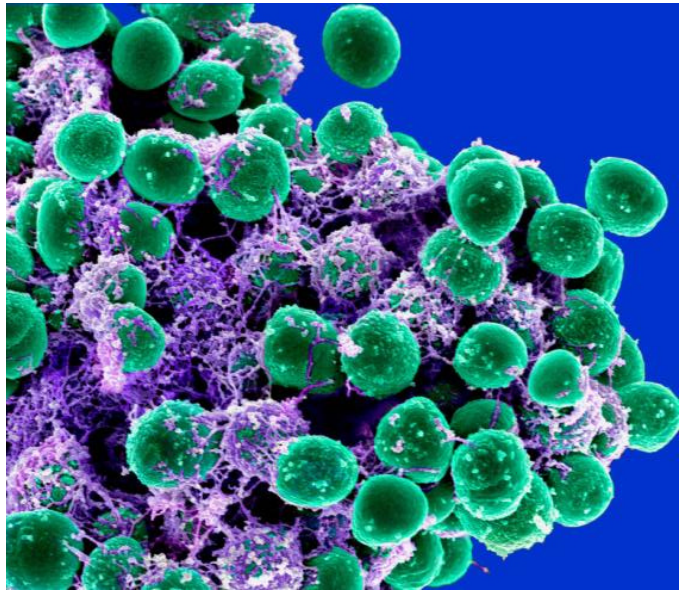

Photo: *Staphylococcus epidermidis* bacteria, NIAID (from flickr).[2]

BASIC LECTURE

UPPSALA UNIVERSITET

By ReAct

Funding from Marie-Claire Cronstedts Stiftelse

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OUTLINE OF THIS LECTURE

- About bacteria
- About antibiotics
- Antibiotic resistance
  - How does it form and spread?
  - What are the consequences for global health?
- What can you do?

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ABOUT BACTERIA

- Bacteria are small (microscopic size) organisms that can be found in most environments, for example in soil, water and on and inside the human body
- There are around 50 million bacteria in every gram of surface soil
- We would not survive without them!
  - Help degrade the food we eat
  - Protect against pathogens

Photo: Bacteria, Umberto Salvagnin (from flickr).[3]

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DISEASE-CAUSING BACTERIA

- A few bacteria can be dangerous to our health by causing infections and even death
- We can get them from outside the body:
  - Other humans, animals, food, water
- Sometimes our “own” bacteria can cause disease
- Examples of bacterial infections:
  - Pneumonia
  - Blood stream infections
  - Urinary tract infections
  - Wound infections
  - The sexually transmitted disease gonorrhea

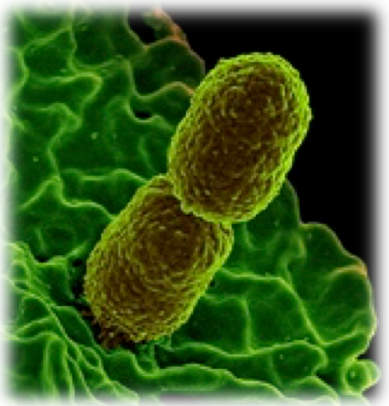

Photo: *Klebsiella pneumoniae*, NIAID (from flickr). [4]

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ANTIBIOTICS

Photo: Antibiotics, Michael Mortensen (from flickr). [5]

- Antibiotics are medicines for bacterial infections
- Examples of antibiotics:
  - Penicillin and Ciprofloxacin
- Penicillin was discovered by Alexander Fleming in 1928
  - Introduced as medicine in the 1940's
- Antibiotics can have "broad" or "narrow" spectrum
  - Broad spectrum: Active against many different types of bacteria
  - Narrow spectrum: Active against one or a few types of bacteria

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ANTIBIOTICS

- **Antibiotics do not work against viruses!**
- Examples of viral infections:
  - The common cold
  - The flu (influenza)

COLD? FLU?
TAKE CARE
NOT ANTIBIOTICS

A European Health Initiative

European Antibiotic Awareness Day key messages, ECDC.

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ANTIBIOTICS

- **Antibiotics are effective against bacteria**
  - However, antibiotics have only marginal effect against some bacterial infections such as uncomplicated sinus infections and ear infections (bacterial otitis)
  - The body's immune system can normally take care of these infections without antibiotics
- But for some bacterial infections antibiotics are **life-saving medicines!**
  - For example for blood stream infections (sepsis) and pneumonia

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ANTIBIOTICS

- Before antibiotics there was no effective cure for bacterial infections
- Antibiotics were considered “a miracle cure”

➔ **Saved countless lives!**

➔ **Made modern medicine possible!**

- **Antibiotics cure infections, prevent infections upon surgery, and make transplantations and cancer treatment safer**

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ANTIBIOTICS

- Antibiotics are the cornerstones of modern medicine!

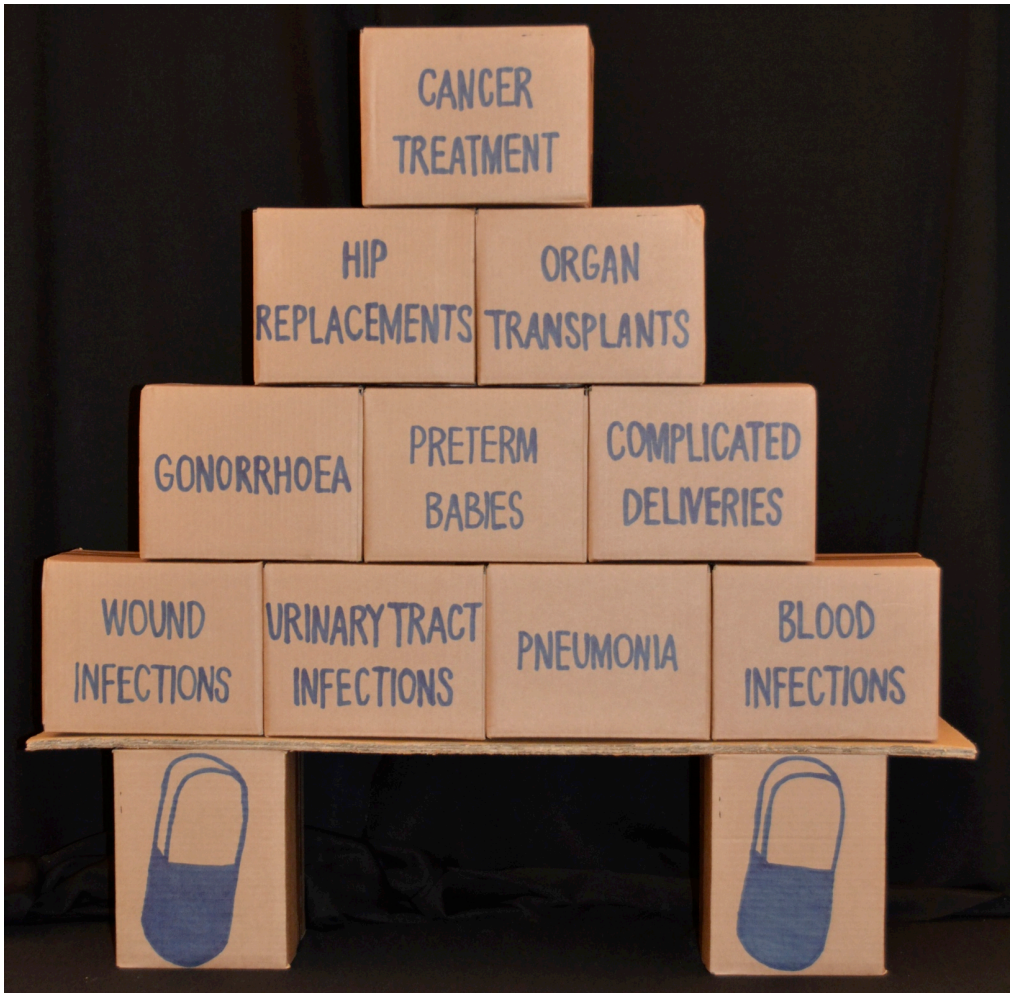

Photo: M. Pränting

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ANTIBIOTIC RESISTANCE

- Massive use of antibiotics the past 80 years, both appropriate and inappropriate has lead to:

Increased occurrence and spread of bacteria that are resistant to antibiotics

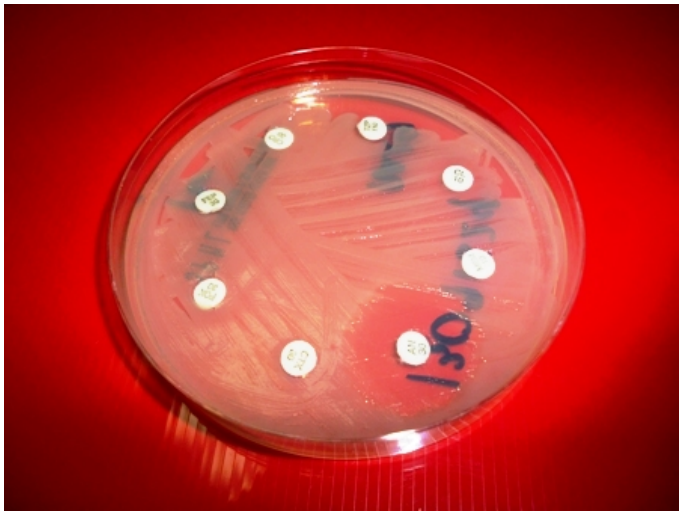

Photo: Drug resistance by Iqbal Osman (from flickr). [6]

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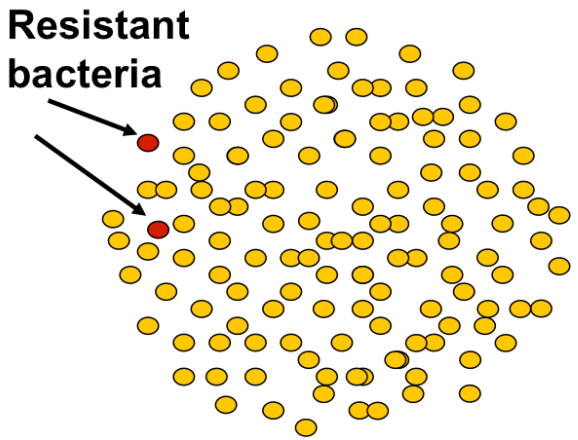
ANTIBIOTIC RESISTANCE

ANTIBIOTIC RESISTANCE = The ability of bacteria to protect themselves against the effects of an antibiotic

- Bacteria are experts at surviving in changing environments
- In large bacterial populations there are often a few resistant bacteria



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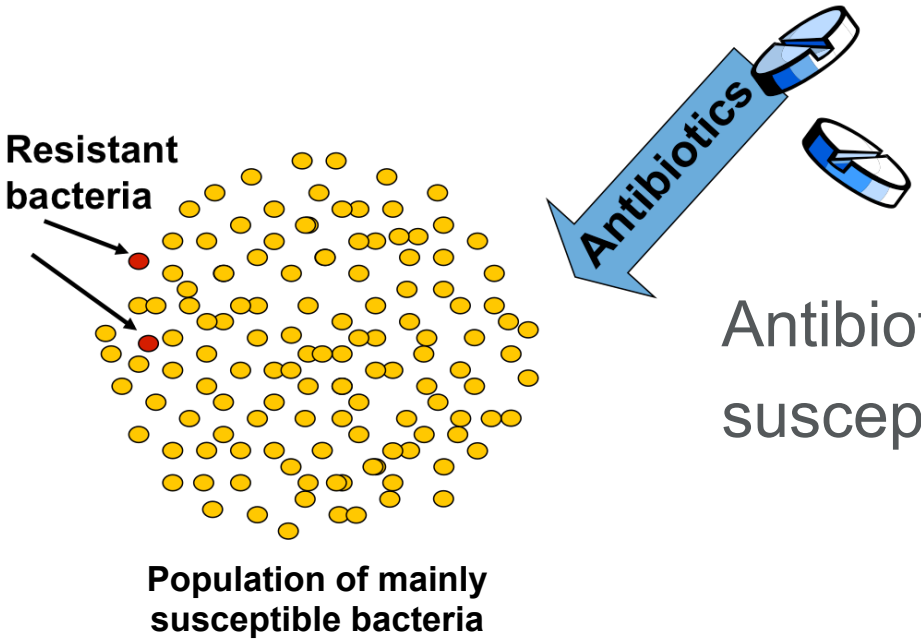
ANTIBIOTIC RESISTANCE

- Antibiotics **select** for resistant bacteria



Antibiotics kill or stop growth of susceptible bacteria

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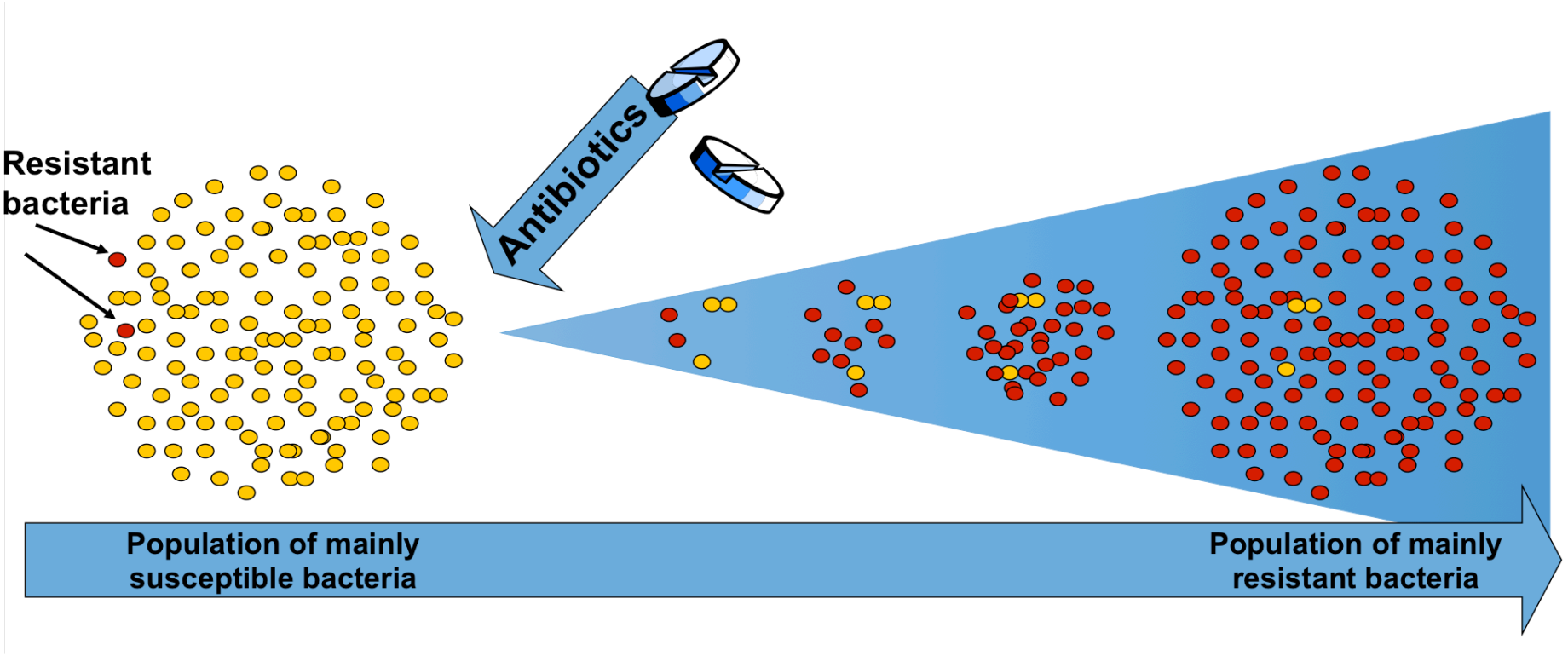
ANTIBIOTIC RESISTANCE

- Antibiotics **select** for resistant bacteria



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ANTIBIOTIC RESISTANCE

Is antibiotic resistance a problem?

- Antibiotic resistance leads to treatment failures
- Antibiotic resistance threatens our ability to perform modern medical procedures
- Antibiotic resistance imposes a major economic burden on society
- Antibiotic resistant bacteria already cause many deaths around the world

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ANTIBIOTIC RESISTANCE

Antibiotic resistant bacteria each year cause:

- More than 38,000 deaths in Thailand[a]
- More than 23,000 deaths in the USA[b]
- 25,000 deaths in the European Union[c]

Photo: Methicillin-Resistant Staphylococcus aureus (MRSA) Bacteria by NIAID (from flickr) [7]

[a]Phumart P, Phodha T *et al*. Health and Economic Impacts of Antimicrobial Resistant Infections in Thailand: A Preliminary Study. J. Health Syst Res. (2012) 6(3).
[b]US Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States, 2013. (2013). http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf
[c]ECDC/EMEA. Technical Report. The bacterial challenge: time to react. (Sept 2009). http://www.ecdc.europa.eu/en/publications/Publications/0909_TER_The_Bacterial_Challenge_Time_to_React.pdf

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ANTIBIOTIC RESISTANCE

… but the consequences of antibiotic resistance are most severe for the poor. For example:

- In South Asia (India, Pakistan, Afghanistan, Nepal, Bangladesh) one **newborn child dies every 5 minutes** from blood stream infections (sepsis) because the antibiotics given are not effective due to bacterial resistance[a]

[a]Bhutta Z, Presentation at *the Global Need for Effective Antibiotics - Moving towards Concerted Action*. http://www.reactgroup.org/uploads/publications/presentations/opening-session-zulfiqar-bhutta.pdf

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ANTIBIOTIC RESISTANCE

- Antibiotic resistance is a **global issue!**
  - Exists on all continents
  - Affects both low- and high income countries
  - Affects both strong and weak health systems

Photo: The Blue Marble, Eastern Hemisphere March 2014, NASA Goddard Space Flight Center (from flickr). [8]

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How did we end up here?

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USE & INAPPROPRIATE USE OF ANTIBIOTICS

- Use in human and animal medicine
- Use to increase growth of farm animals
- Use for routine prophylaxis in farm animals

→ Selection and maintenance of resistance

How did we end up here?

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USE & INAPPROPRIATE USE OF ANTIBIOTICS

→ Selection and maintenance of resistance

SPREAD OF RESISTANT BACTERIA

- Poor hygiene and sanitation
- Food and water
- Travel

How did we end up here?

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USE & INAPPROPRIATE USE OF ANTIBIOTICS

→ Selection and maintenance of resistance

SPREAD OF RESISTANT BACTERIA

How did we end up here?

LACK OF NEW ANTIBIOTICS

- The last new antibiotic class that has been introduced as medicine was discovered in 1987
- Older antibiotics are rapidly becoming ineffective due to antibiotic resistance

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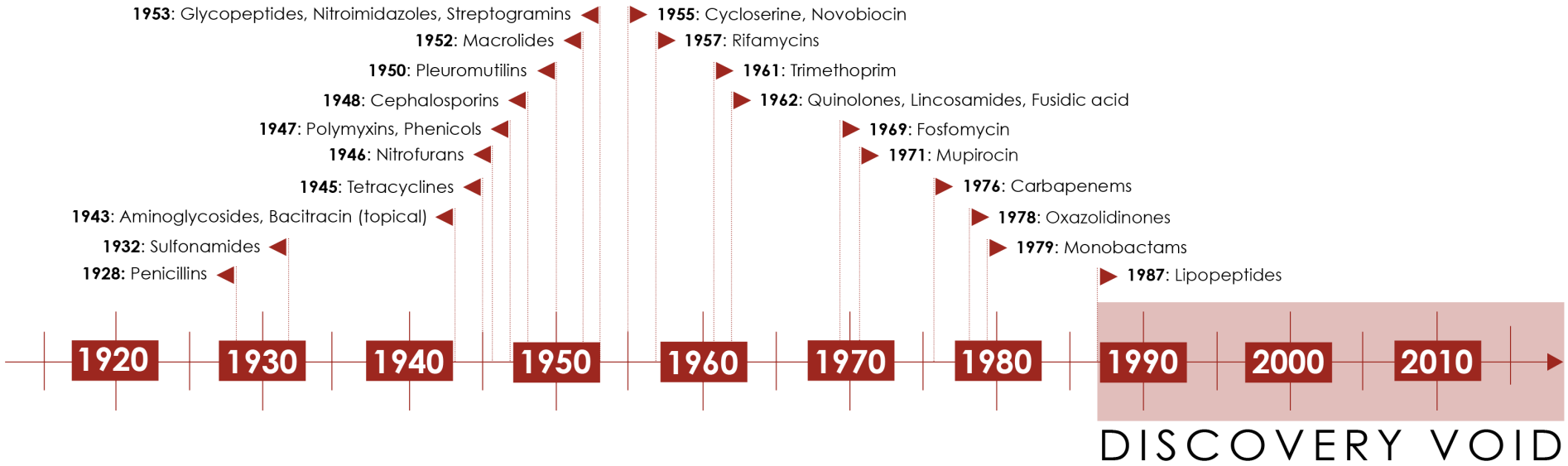
LACK OF NEW ANTIBIOTICS



Adapted from Silver 2011

- No new drugs for typhoid fever, gonorrhea, blood stream infections or postoperative infections
- Some bacteria already resistant to all available antibiotics

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WHAT CAN YOU DO?

- Use antibiotics **only** when you need it
  - Not for a common cold or the flu
- Ask your doctor for advise
  - Don’t pressure
  - Don’t self medicate
- Wash your hands, especially….
  - Before and after handling and preparing food
  - After visiting the bathroom
- Teach others about antibiotic resistance!

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Thank you for your attention!

For more information about antibiotic resistance, please visit:

www.reactgroup.org
www.reactgroup.org/toolbox

Image references

[1] Photo: Mycobacterium tuberculosis Bacteria, the Cause of TB by NIAID (from flickr)
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[3] Photo: Bacteria by Umberto Salvagnin (from flickr)
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[6] Photo: Drug resistance by Iqbal Osman (from flickr)
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