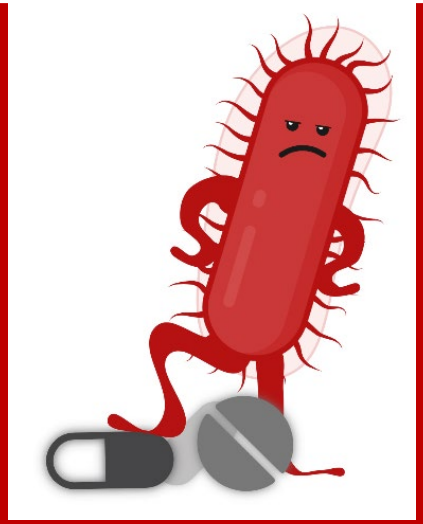
Empa
Materials Science and Technology

Antimicrobial Resistance (AMR)



"With antibiotic substances
AMR occurs naturally over time…"

Dr. Qun Ren, Group Leader
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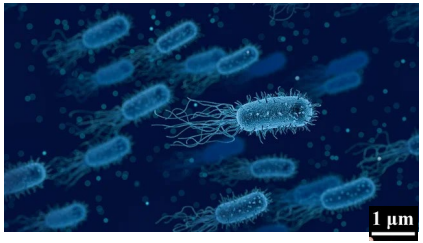
Empa, St. Gallen

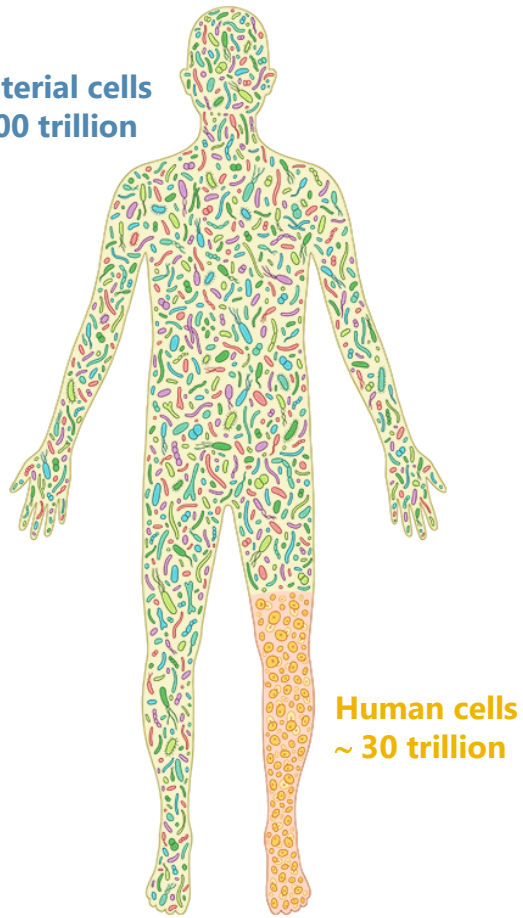
Antimicrobial resistance (AMR)

- Antimicrobial resistance (AMR) refers to the ability of microorganisms, such as **bacteria**, viruses, and fungi, to resist the effects of antimicrobial drugs.

Prevalence of bacteria



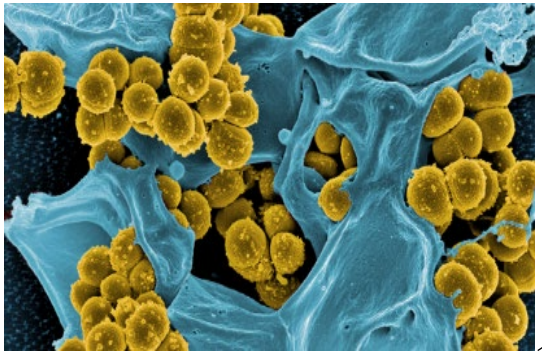
Bacteria are everywhere on Earth and are vital to the planet's ecosystems.

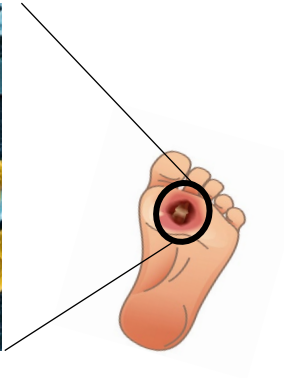


https://www.amnh.org/explore/science-topics/microbiome-health/meet-your-microbiome

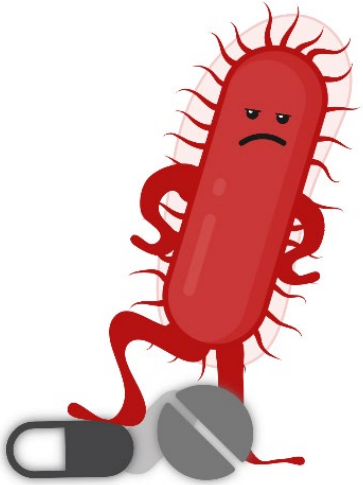
Infection happens

Invasion of pathogens





Antimicrobial treatment

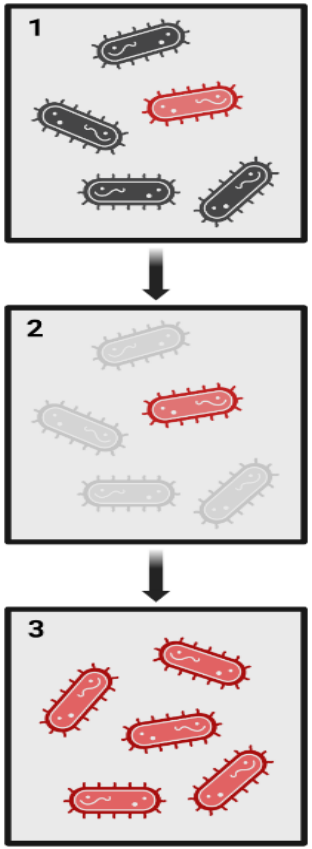


Antimicrobial Resistance (AMR)

AMR occurs naturally over time… Why?

How does AMR arise?

Microbes are living organisms that naturally evolve.



Mutation:
In a population of bacteria, a bacterium randomly mutates and develops antibiotic resistance.

Selection:
When exposed to an antibiotic near a lethal concentration, all the bacteria die except the resistant one.

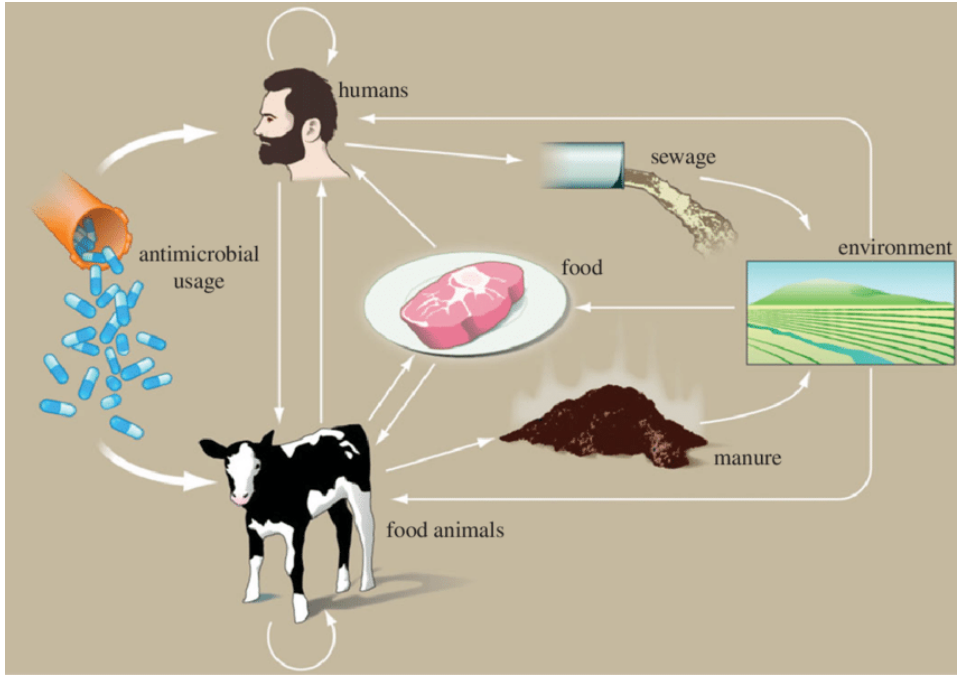
Multiplication:
The antibiotic resistant bacterium reproduces and can acquire additional resistances.

Causes of AMR

- Overuse and misuse of antimicrobial drugs in humans, livestock and agriculture
- Poor measures for infection prevention and control action
- Lack of new antimicrobial drug development

AMR spread!

There are many means for AMR spread, with misuse of antimicrobials as one of the key contributors.



Emergence of AMR

https://www.cdc.gov/sepsis/datareports/index.html

Superbugs (SUPER strong bacteria that have developed resistance to all manmade antibiotics)

Consequences of AMR

- Increased morbidity and mortality rates
- Prolonged illness and hospital stays
- Increased healthcare costs
- Superbugs development

Impact of AMR

4.95 million Death associated with AMR infections

$20 billion Direct health costs due to AMR per year

Estimated number of yearly deaths globally by 2050 if we do not act now. **10 million**

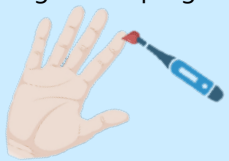
Silent pandemic

Empa research on AMR

Diagnostics: rapid detection to improve the use of antimicrobials

Biosensors

Diagnostics/prognostics

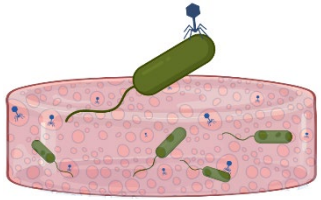


- Severity of infection
- Pathogen(s)
- Drug susceptibility

Therapeutics: novel alternatives to antibiotics

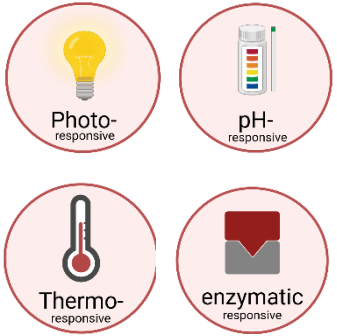
Materials

Living materials



Probiotics, phages

Functional materials



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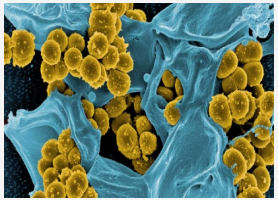
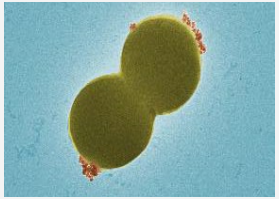
Empa research on AMR

AMR detection



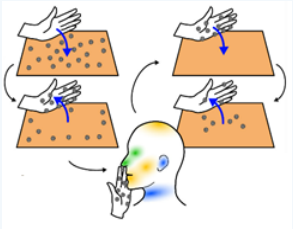
Antibiotic-resistant staphylococci (yellow) are fought by a white blood cell (blue)



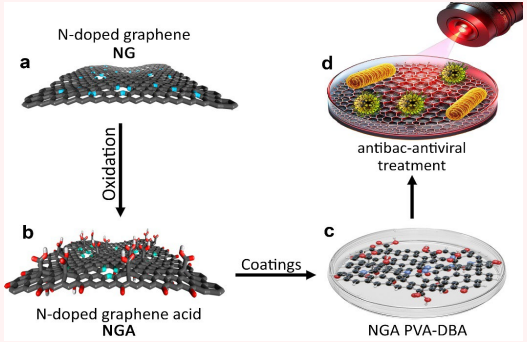
Magnetic nanoparticles (red) bind specifically to the spherical bacteria (yellow)

STOP transfer

Transmission of pathogens via surfaces is a major route of AMR spread.



Antimicrobial materials



Thank you

Collaborative Efforts to Address AMR

- **Global Action** Plan on AMR
- **Collaborations** between governments, healthcare organizations, pharmaceutical companies, and research institutions
- **Action from individuals and organizations** to contribute to the fight against AMR
  - Promote **appropriate use** of antimicrobial drugs
  - Implement **guidelines** for prescribing antibiotics
  - Improve **hygiene practices** in healthcare settings
- Development of **New Antimicrobial** Drugs/Materials
  - Encourage research and development of novel antibiotics and alternative treatments
  - Incentivize pharmaceutical companies to invest in AMR research