



“Hi, I’m Superbug”: AMRs Devastating Effects

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What are Antimicrobials?

- Kill or slow down the spread of microorganisms like bacteria, viruses, and fungi without damaging the host.

- Discovery of the first antibiotic in 1928 sparked an era of new antimicrobials.

- Antibiotics can be classified based on their role or how they target the bacterial cell.

- ❖ Protein Synthesis Inhibitors
- ❖ Cell Wall Synthesis Inhibitors (B-lactam are the most common types of antibiotics prescribed)
- ❖ Nucleic Acid Synthesis Inhibitors

Cell Wall Synthesis

Beta Lactams

Penicillins
Cephalosporins
Carbapenems
Monobactams

Vancomycin
Bacitracin

Cell Membrane
Polymyxins

Folate synthesis

Sulfonamides
Trimethoprim

THF A
DHF A
PABA

Nucleic Acid Synthesis

DNA Gyrase
Quinolones

RNA Polymerase
Rifampin

50S subunit
Macrolides
Clindamycin
Linezolid
Chloramphenicol
Streptogramins

30S subunit
Tetracyclines
Aminoglycosides

Protein Synthesis

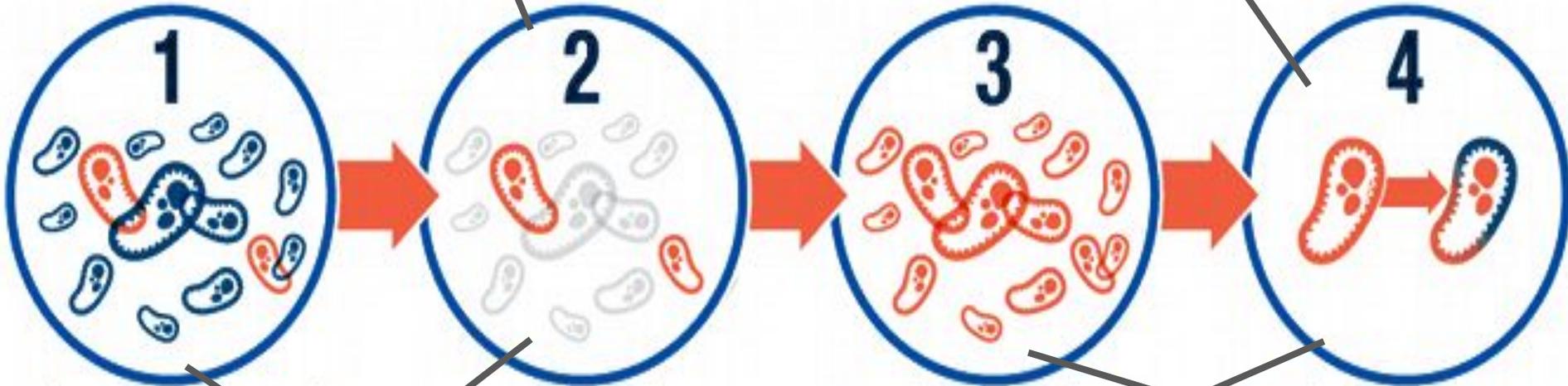
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The antibiotics will attack specific parts of the bacterial cell to kill it. The cell wall, cell membrane, ribosomes, DNA, or RNA

What is AMR?

There is no competition for the resistant bacteria. Allowing it to have access to lots of space and nutrients.

They will reproduce through binary fission, conjugation, and simple leaving their DNA at death.



Antimicrobial resistance occurs due to the evolution that occurs in bacteria, virus and fungi over time due to selective pressure.

Resistance mechanisms are developed using instructions provided by the DNA and the resistance genes will be found in plasmids, which can be shared to other.

Misuse and Self Medication of Antimicrobials

- Misuse and overuse of antimicrobials often occur because patients will pressure, and ask to receive unnecessary prescriptions.

- ❖ From 675 community pharmacies from 9 provinces, 86% gave antibiotics without any prescription. From 220 online pharmacies from 9 provinces, 79% gave antibiotics without any prescription.
- ❖ $\frac{1}{3}$ to $\frac{1}{2}$ of antibiotic use in humans is unnecessary or inappropriate according to the Centers for Disease and Control

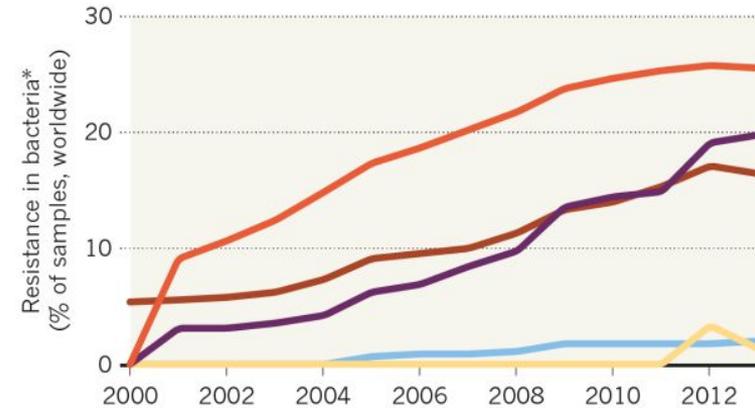
- Self medication is a form of misuse.

- ❖ in Malaysia where a total of 649 students (medical and non-medical students) reported they self medicate, and 89% believe it is good.

THE SPREAD OF ANTIBIOTIC RESISTANCE

An increasing proportion of bacteria display resistance to common antibiotics.

— Fluoroquinolones — Cephalosporins (3rd gen) — Aminoglycosides
— Carbapenems — Polymyxins

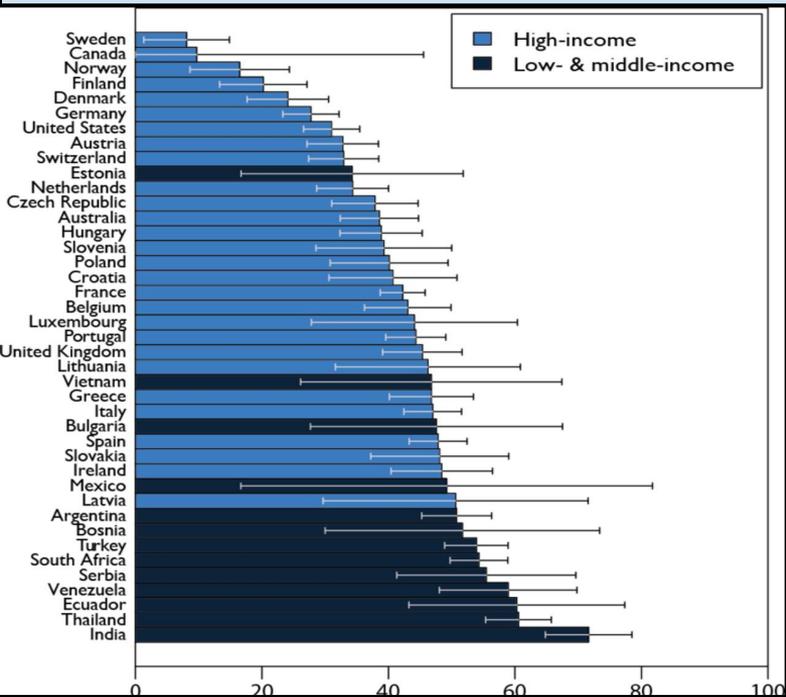


*Enterobacteriaceae, including *Escherichia coli*, *Klebsellia pneumonia*, *Enterobacter* and *Salmonella*

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Shows how most bacteria have developed a resistance to common antibiotics that are prescribed. This shows how bacterial cells will continue to evolve and develop resistant genes under a selective pressure. We can't stop antimicrobial resistance but we can slow it down if we stop misuse and self medication

Spread of Antimicrobial Resistance



- Animals, people, food, plants, and the environment carry resistant genes that can easily be spread between them. Ex) Antibiotic pollution

- Bacteria evolve differently depending on the environment and selective pressure. Therefore it makes antimicrobial resistance more common in some countries, and makes different countries have different types of resistant bacteria. Ex) India has the most resistant pathogens

- Cholera outbreak in Soho London, killed 600 people in one week due to sewage that was dumped in rivers and got into the water supply.

Low and middle income countries had high DRI scores as antibiotics are cheap and easily accessible. High income countries had low DRI scores as antibiotic are more expensive and effective.

AMR in Hospitals

- Nosocomial infections occur in hospitals, nursing homes, and surgical centres and affect up to 15% of hospitalized patients.

- There is a growing resistance in these microbes and can spread between patients, workers and visitors through indirect and direct contact.

- However so far sanitation is only chemically based, but it is shown that 50% of surfaces aren't properly decontaminated, and recontamination occurs as fast as 30 minutes. Some solutions may be

- ❖ Screening patients for resistant bacteria
- ❖ UV light
- ❖ Self Disinfecting Systems (uses metals like iron, copper, and silver)

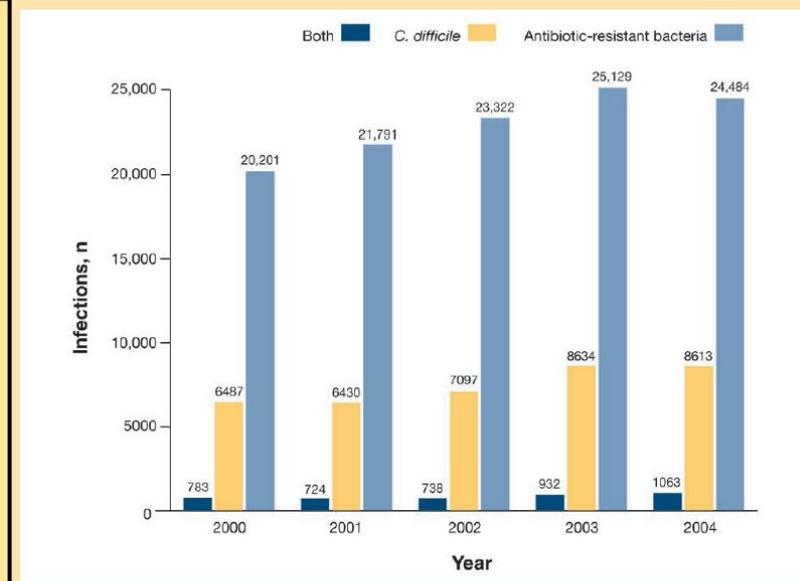


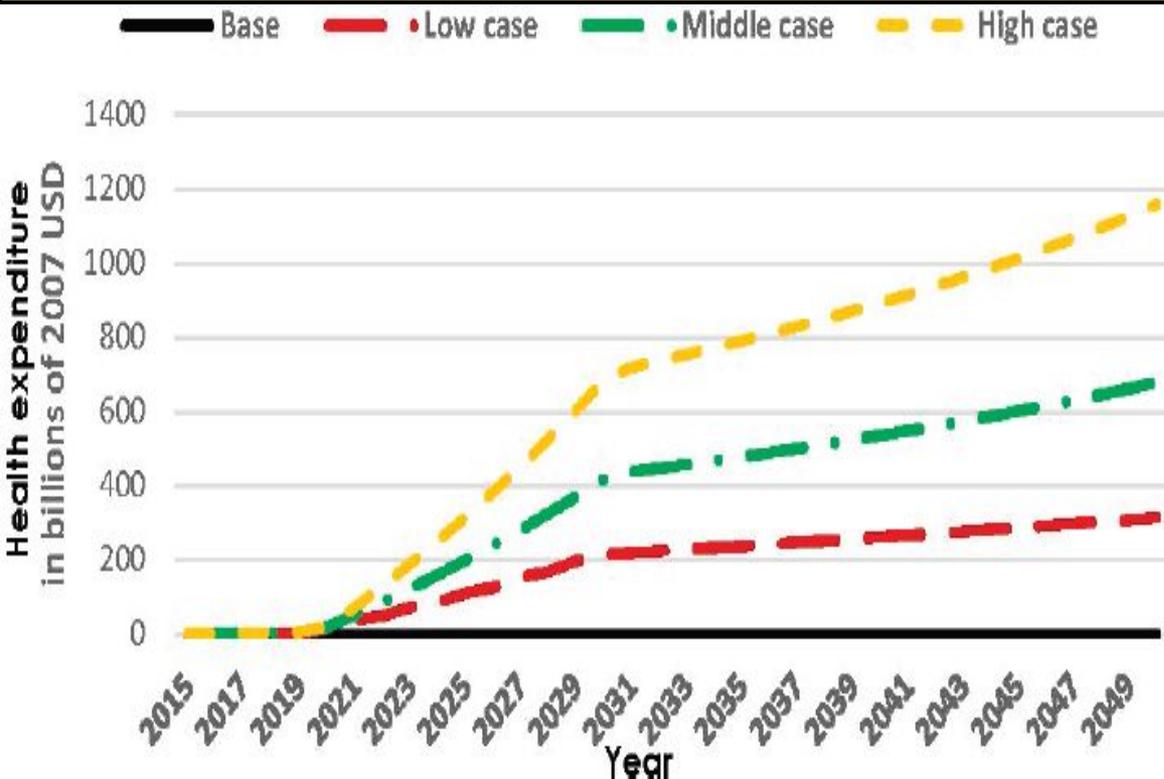
Figure. The chart represents current trends in the incidence of infections caused by antibiotic resistant pathogens in US nursing homes. The light blue bars represent methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and betalactam-resistant Gram-negative bacterial infections. The yellow bars represent *Clostridium difficile* infections. The dark blue bars include infections caused by all of these organisms.

Source: Reproduced with permission from *Infect Control Hosp Epidemiol*.¹

This graph shows the deaths caused by resistant nosocomial infections in nursing homes annually in the US. Proper hand hygiene, sanitation, and tracking has to be placed.

Economic Effect of AMR

AMR not only leads to prolonged illnesses, death, and disabilities, but the need for more expensive medicine, treatments, and longer hospital stays. In Canada there are about 250,000 cases of AMR, with 5,400 deaths. However by 2050, there will be 400,000 cases, and 7,000 deaths.



This graph was created by the World Bank to show the effect of antimicrobial resistance on the global economy. As presented the low case assumes a 5% resistance rate. The middle case assumes that the resistance rate will be 40%. The high case represents a 100% resistance rate. If the spread of AMR doesn't slow down, it could cost the global economy 10 trillion dollars by 2050.

Spreading Awareness on AMR

The collaboration of local communities, nations, and the globe is needed to help address antimicrobial resistance that spreads through different sectors in the community.

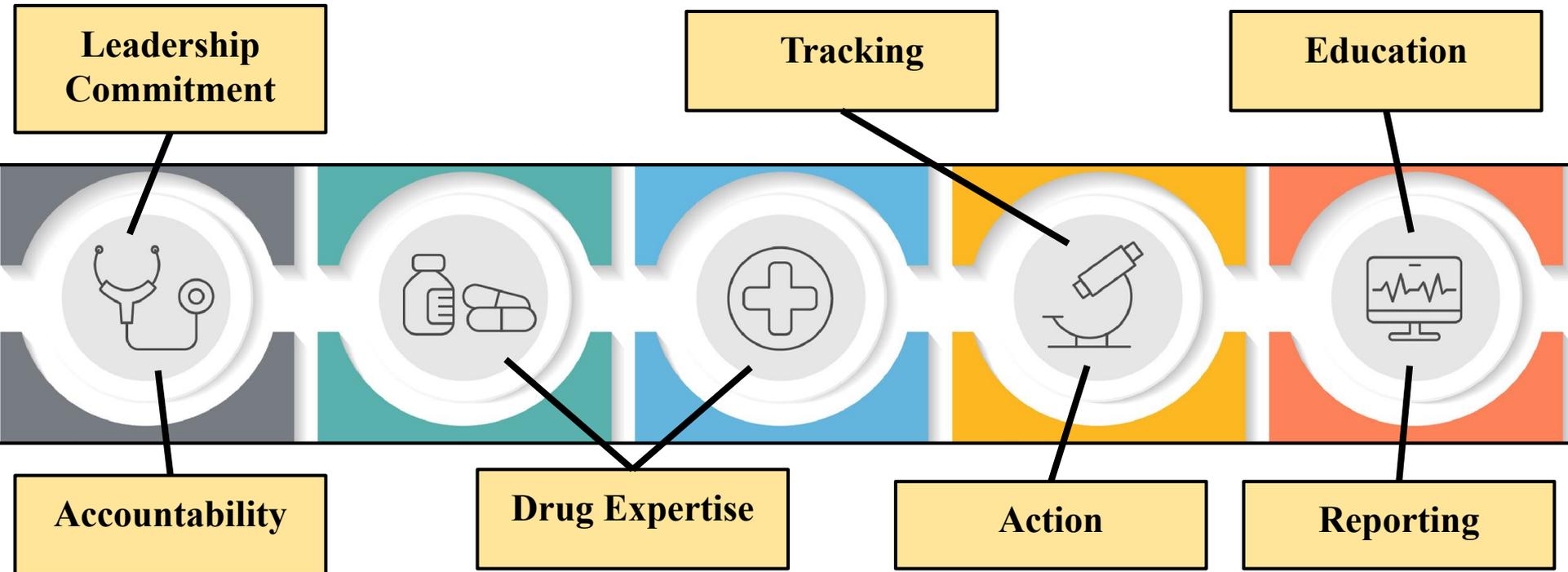
Global: WHO, Food and Agriculture Organization of the United Nations, and the World Organization for Animal Health have worked together to form the global action plan.

National: Canada is addressing antimicrobial resistance by releasing a federal framework for proper use of antimicrobials in Canada. Addressing areas of surveillance, stewardship, and innovation.

Local: The University of Calgary is working on 27 projects through a pan-Alberta platform called the one health consortium to help slow AMR.

Antimicrobial Stewardship Programs

Antimicrobial stewardship is a way to improve how antibiotics are prescribed by clinicians and used by patients. These following core elements are created by the CDC to outline antibiotic stewardship programs.



Finding A Cost Effective Solution To Antimicrobial Shortages

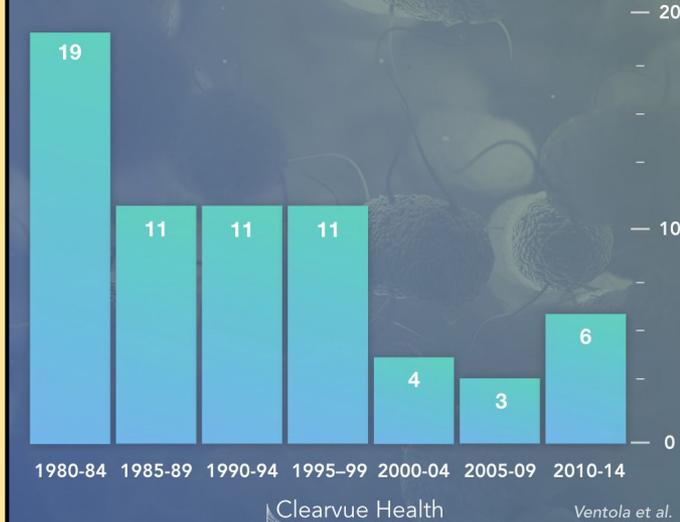
- It has become quite complex and proper consideration has to be taken on the impact of antimicrobial resistance on the infection. Therefore resulting in one, or multiple antibiotics being prescribed depending on the specific strain in the environment and the selective pressure.

- Lack of research into new drugs, and more resistance, makes antimicrobial shortages prone to occur, and we either have to find a solution or an alternative.

- ❖ Vaccines
- ❖ Probiotics and Antibiotics- Statistical analysis has shown that a probiotic paired with an antibiotic resulted in a 66% reduction of C difficile-associated diarrhea
- ❖ Communication and Proper Legislation

New Antibiotic Approvals

While antibiotic resistance rises, fewer new antibiotics are being developed and approved.



This graph shows how the late 1900s was the golden era of created and approved antibiotics. While in the 2000s antibiotics may have been created none have been approved currently.

COVID-19

The spread of the novel coronavirus has led to the confirmation of proper hand hygiene being hugely important.

Vaccines are what we need as they are an effective way to help slow down the spread of AMR, and become a replacement for antimicrobials.



You should follow the proper instructions on how to wash your hands with soap. As lathering, scrubbing the soap against your hands physically destroys and removes germs from your skin and entering into your body.

The repeated exposure to these alcohol based disinfectants tends to allow microbes to slowly mutate and make them resistant, and continue to survive.