The Antimicrobial Resistance Crisis:

Exploring the Role of Climate Medicine in Clinical Practice

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Speaker Disclosure

Paola DeCicco, BSc, ND

I am a paid advisor to Nestlé Health Science. I have no other conflicts of interest to disclose.

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Agenda

1. **Climate Medicine: Definition & Relevance to AMR**
2. AMR: Definition, Key Stats & MoA
3. AMR: Primary Contributors
4. Solutions: Current Strategies

Climate Medicine: Definition

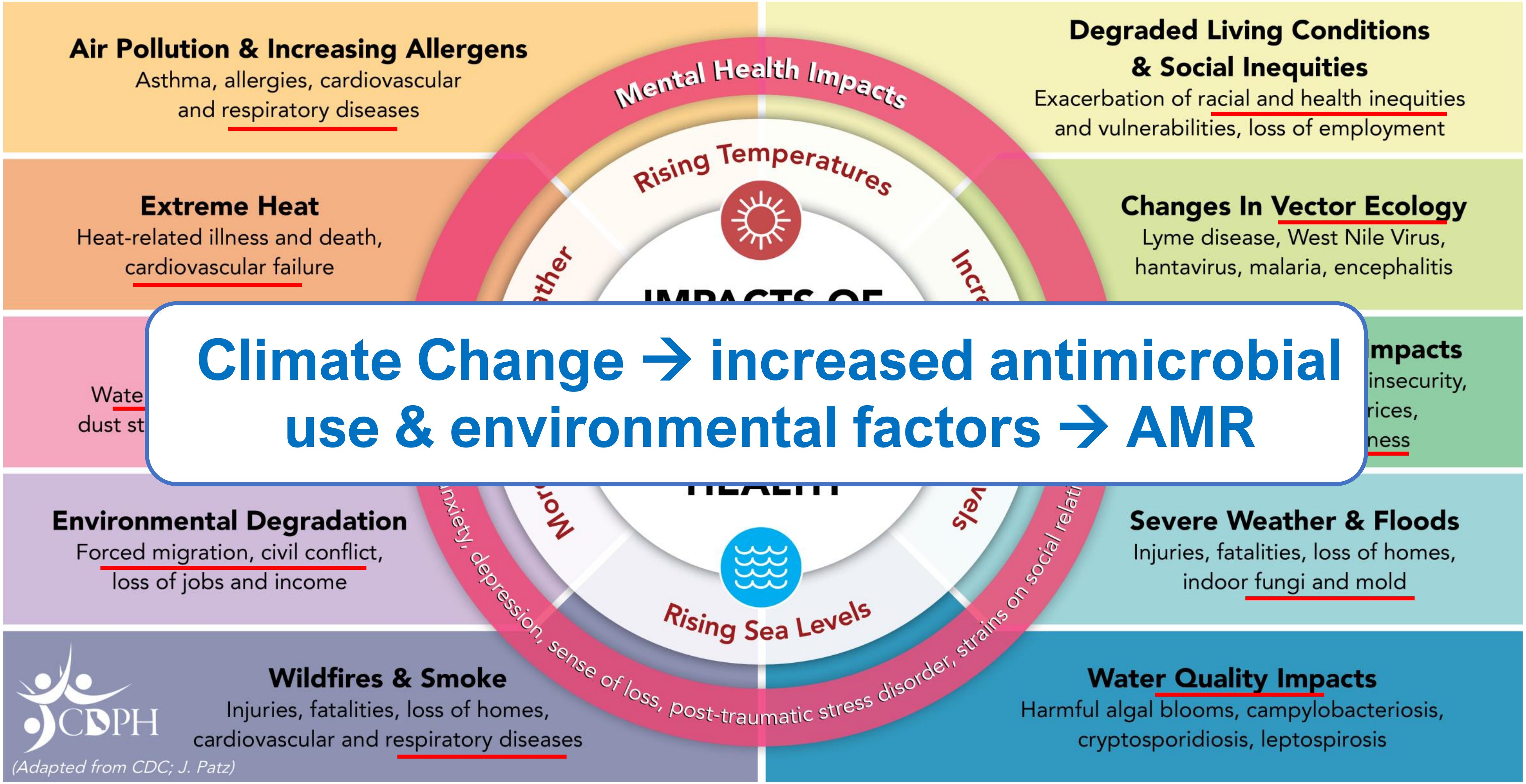
"Climate medicine examines how climate change impacts human physical and mental health through environmental exposure pathways including natural disasters/extreme weather, changes in water quality and quantity, food insecurity, heat stress, air pollution and vector borne infections." https://cmecatalog.hms.harvard.edu/climate-change-planetary-health-medicine

Climate change is defined by WHO as one of the biggest health threats of the 21st century.

"The climate crisis is a health crisis, resulting in a tremendous burden on healthcare providers and systems, driving the need to adapt to these changing determinants of health."

CAND Journal, *31*(4), 11–15.

Climate Change → increased antimicrobial use & environmental factors → AMR



California Department of Public Health

Climate Medicine:

Climate destruction poses **higher risks** for the marginalized:

Indigenous people, those who are racially marginalized, people living in poverty, people living with disabilities, the elderly, people experiencing homelessness.

Solomonian, L. (2024). CAND Journal, 31(4), 11–15.

In 2019, mortality rates from antimicrobial-resistant infections were highest in low- and middle-income countries.

The countries with the highest burden of AMR had more than **4 times** the number of AMR-attributable deaths compared to countries with the lowest burden. Lancet. 2022;399(10325):629-655.

Agenda

1. Climate Medicine: Definition & Relevance to AMR
2. **AMR: Definition, Key Stats & MoA**
3. AMR: Primary Contributors
4. Solutions: Current Strategies

AMR: Definition

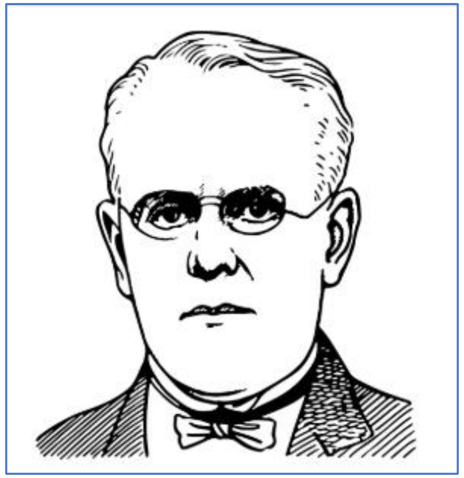
Antimicrobial resistance (AMR) refers to microbes that no longer respond to treatment by antimicrobial drugs.

https://cca-cac.yearly.report/amr-impact-story-en#/-O34mKgpd1IPM2uVBt8J

"This is a slow growing pandemic."

Dr. Mukesh Kapila - member of WHO advisory group for antimicrobial resistance

AMR: Definition



In 1945 Nobel prize acceptance speech, Dr. Alfred Flemming, the inventor of penicillin in 1928, warned us about antibiotic resistance.

"The more you use, the more you lose."

AMR: Definition

Following the discovery of penicillin in 1928, 20 novel structural classes of antibiotics were developed between 1930 and 1960.

However, stagnation in the discovery or development of new antimicrobial classes since the 1980s has led to over-reliance on the existing antibiotics.

$600M - $1B to create a new antibiotic

most pharma has pivoted to vaccine development

Ho, Charlotte S et al. The Lancet Microbe, Volume 6, Issue 1, 100947

AMR: Key Stats - Canada

	Infections in Canada resistant to the drugs used to treat them	Lives lost annually in Canada as a direct result of AMR	Annual cost to the Canadian health care system attributable to AMR
2018	26%	5,400	$1.4B
2050 projection	40%	13,700	$7.6B

https://cca-reports.ca/wp-content/uploads/2023/05/Updated-AMR-report_EN.pdf

AMR: Key Stats - Canada

	Infections in Canada resistant to the drugs used to treat them	Lives lost annually in Canada as a direct result of AMR	Annual cost to the Canadian health care system attributable to AMR
2018	26%	5,400	$1.4B
2050 projection	[illegible]	[illegible]	[illegible].6B

By 2050, drug resistance will kill more people each year than cancer and heart disease and cost the world as much as **$100 trillion** in lost economic output.

https://cca-reports.ca/wp-content/uploads/2023/05/Updated-AMR-report_EN.pdf

AMR: Global Threats - WHO & CDC

Drug-Resistant Pathogen	Common Infections Caused
Carbapenem-Resistant & ESBL-Producing Enterobacteriaceae (*Klebsiella pneumoniae, E. coli*)	UTIs, sepsis, pneumonia, intra-abdominal infections
Methicillin-Resistant Staphylococcus aureus (MRSA)	Skin & soft tissue infections, pneumonia, bacteremia, endocarditis, osteomyelitis
Multidrug-Resistant Acinetobacter baumannii	Hospital-acquired pneumonia, ventilator-associated pneumonia (VAP), sepsis, wound infections
Multidrug-Resistant Pseudomonas aeruginosa	Pneumonia, UTIs, sepsis, wound infections
Drug-Resistant Mycobacterium tuberculosis	Drug-resistant TB
Vancomycin-Resistant Enterococci (VRE) *(E. faecium, E. faecalis)*	Sepsis, endocarditis, UTIs, intra-abdominal infections
Fluoroquinolone-Resistant Salmonella & Shigella	Severe diarrheal disease, systemic infections

AMR: MoA

AMR: MoA

Mechanism	Description
Enzymatic Destruction or Inactivation	Bacteria produce enzymes that **destroy or modify the antibiotic**.
Efflux Pumps	Membrane proteins actively **pump antibiotics out of the bacterial cell**.
Reduced Permeability / Decreased Uptake	Altered outer membrane or porins **limit drug entry**.
Target Site Modification	Mutation or alteration of the **antibiotic's binding site**.
Bypass Pathways	Alternative metabolic pathways **circumvent antibiotic action**.
Biofilm Formation	Bacteria form structured communities that **block antibiotic penetration**.
Horizontal Gene Transfer	Acquisition of **resistance genes from other bacteria**.

McInnes RS, et al. Curr Opin Microbiol. 2020;53:35-43.
Habboush, Y., & Guzman, N. (2023). Antibiotic resistance. In StatPearls [Internet]. Treasure Island, FL: StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK513277/
Zhu S, et al. Ecotoxicol Environ Saf. Published online June 14, 2023.
Ho CS, et al. Lancet Microbe. 2025;6(1):100947.

Agenda

1. Climate Medicine: Definition & Relevance to AMR
2. AMR: Definition, Key Stats & MoA
3. **AMR: Primary Contributors**
4. Solutions: Current Strategies

AMR: Primary Contributors

Antimicrobial Use	Environmental Factors
(1) Health Care	(4) Climate Change
(2) Agriculture	(5) Vectors
(3) Commercial Products	(6) Water systems
	(7) Environmental Toxins
	(8) Pharmaceutical Drugs
	(9) Biofilms

https://courses.edx.org/c4x/KIx/KIGlobalHx/asset/Lancet_2.pdf
Rodríguez-Verdugo A, et al. *iScience*. 2020;23(4):101024.
World Health Organization (WHO). (2023, November 21). Antimicrobial resistance: Key facts. World Health Organization.
United Nations Environment Programme (UNEP). (2023). Bracing for superbugs: Strengthening environmental action in the One Health response to antimicrobial resistance. Nairobi: UNEP.

(1) AMR: Antimicrobial Use in Health Care

<u>CDC</u>
30% antibiotics rx in US are wrongful or unnecessary

<u>Ontario</u>
25% of all antibiotic rx were likely unnecessary

<u>COVID-19 pandemic</u>
intensified antibiotic usage and accelerated the development of pathogen resistance

47 million prescriptions!

Crosby M, et al. CMAJ Open. 2022 Mar 22;10(1):E262-E268. doi: 10.9778/cmajo.20210095.
Kariyawasam RM, et al. Antimicrob Resist Infect Control. 2022;11(1):45. Published 2022 Mar 7.

AMR: Antimicrobial Use in Health Care

"Immediately following a course of antibiotics, there is rapid reduction in the … (biomass) and bacterial species …, particularly health-associated … bacteria like *Bifidobacterium, Lactobacillus* and *Bacteroides* species.

This is accompanied by an initial bloom of potential pathogens that can cause healthcare-associated infections, including *Enterococcus, Clostridium, E. coli, Kleb. Pneumoniae, and Candida* → increase in **ARG (antimicrobial resistant genes)**.

The unintended harm caused by antibiotics on the gut microbiome, called MICROBIOTOXICITY.

McInnes RS, et al. Curr Opin Microbiol. 2020;53:35-43.

AMR: Antimicrobial Use in Health Care

How long AFTER antibiotic exposure can it take for AMR to occur?

a) 0-3 months
b) 0-6 months
c) 1-2 years
d) 5-10 years

Poku E, et al. JAC Antimicrob Resist. 2023 Jan 20;5(1):dlad001.

AMR: Antimicrobial Use in Health Care

What evidence-based intervention has been shown to benefit this undesirable scenario?

PROBIOTICS …

The unintended harm caused by antibiotics on the gut microbiome, called MICROBIOTOXICITY.

John D, et al. Front Microbiomes. 2024;3:1359580.

(2) AMR: Antimicrobial Use in Agriculture

- Animals consume ~ 1.5x the amount of antibiotics compared to humans
- 80% (by volume) of antibiotics both produced in US & those sold in Canada goes into to food-producing animals or horses
- Chicken raised with antibiotics have been shown to have 9x more AMR
- Vegetarians are not excluded; animal manure is used in raising crops

https://www.nytimes.com/video/health/100000005932983/bacteria-antibiotics-war.html?smid=url-share
https://www.canada.ca/en/public-health/services/publications/drugs-health-products/pan-canadian-action-plan-antimicrobial-resistance.html#message
Rodríguez-Verdugo A, et al. *iScience*. 2020;23(4):101024.

AMR: Antimicrobial Use in Agriculture

- Animals consume ~ 1.5x the amount of antibiotics compared to humans
- 80%
  into
- Chi
- Vegetarians are not excluded; animal manure is used in raising crops

The combined impact of 40% resistance to first-line antimicrobials on human labour productivity and on animal productivity could cost the animal farming industry **$225 billion between 2020 and 2050**

https://www.nytimes.com/video/health/100000005932983/bacteria-antibiotics-war.html?smid=url-share
https://www.canada.ca/en/public-health/services/publications/drugs-health-products/pan-canadian-action-plan-antimicrobial-resistance.html#message
Rodríguez-Verdugo A, et al. *iScience*. 2020;23(4):101024.

(3) AMR: Antimicrobial Use in Commercial Products

- Soaps
- Cosmetics
- Cleaning sprays
- Menstrual products

Zhu S, et al. Ecotoxicol Environ Saf. Published online June 14, 2023.

(4) AMR: Climate Change

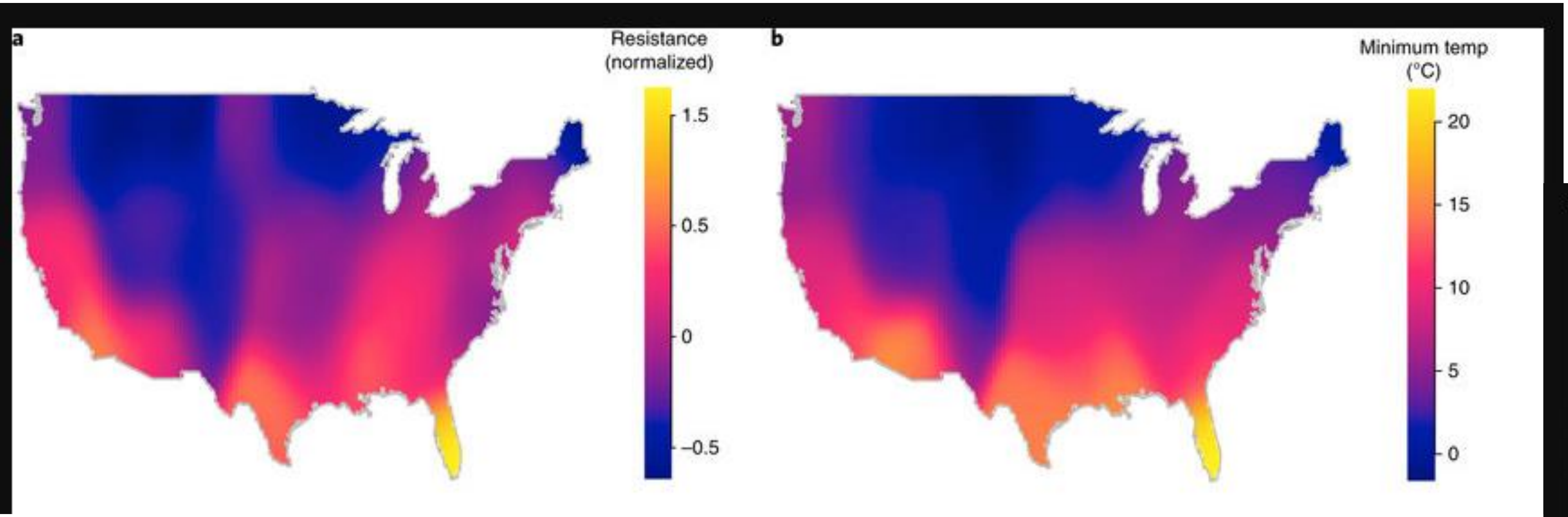
2024 marked the hottest year on record:

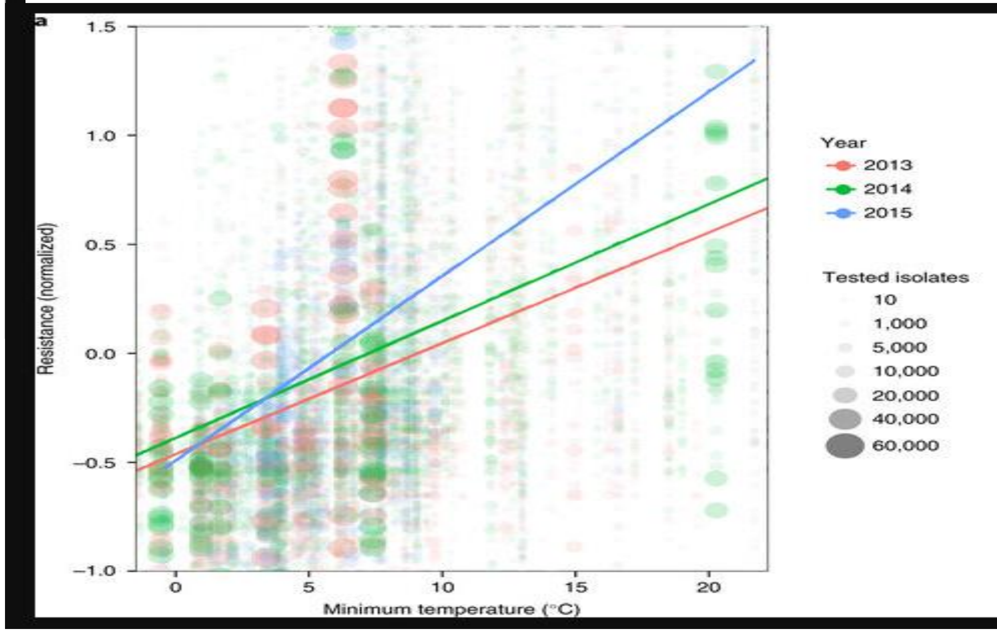
- breaching 1.5 °C of warming from pre-industrial temperatures
- Canada closer to 3.2 °C

changes in temperature can harm cellular processes in ways similar to harm caused by antibiotics, selecting for antibiotic resistant mutations

Mitchell, D. (2025, January 21). Why we still don't know the mounting health risks of climate change. Nature. https://doi.org/10.1038/d41586-025-00149-5
Rodríguez-Verdugo A, et al. iScience. 2020;23(4):101024.

AMR: Climate Change





<u>Antibiotic resistance increases with increasing temperature</u>

a: A heat map of the mean normalized antibiotic resistance for **E. coli** for all antibiotics across the US

b: A heat map of the 30-year average minimum temperature (°C) across the US

c: A scatter plot of antibiotic resistance vs minimum temperature (°C) for **E. coli and amoxicillin**

MacFadden DR, et al. Nat Clim Chang. 2018;8(6):510-514.

AMR: Climate Change

An increase in temperature of 10 °C across regions was associated with an increases in antibiotic resistance of 4.2%, 2.2%, and 2.7% for the common pathogens *E. coli*, *Kleb. pneumoniae* and *Staph. aureus.*

MacFadden DR, et al. Nat Clim Chang. 2018;8(6):510-514.

AMR global threats
– WHO & CDC

(5) AMR: Vectors

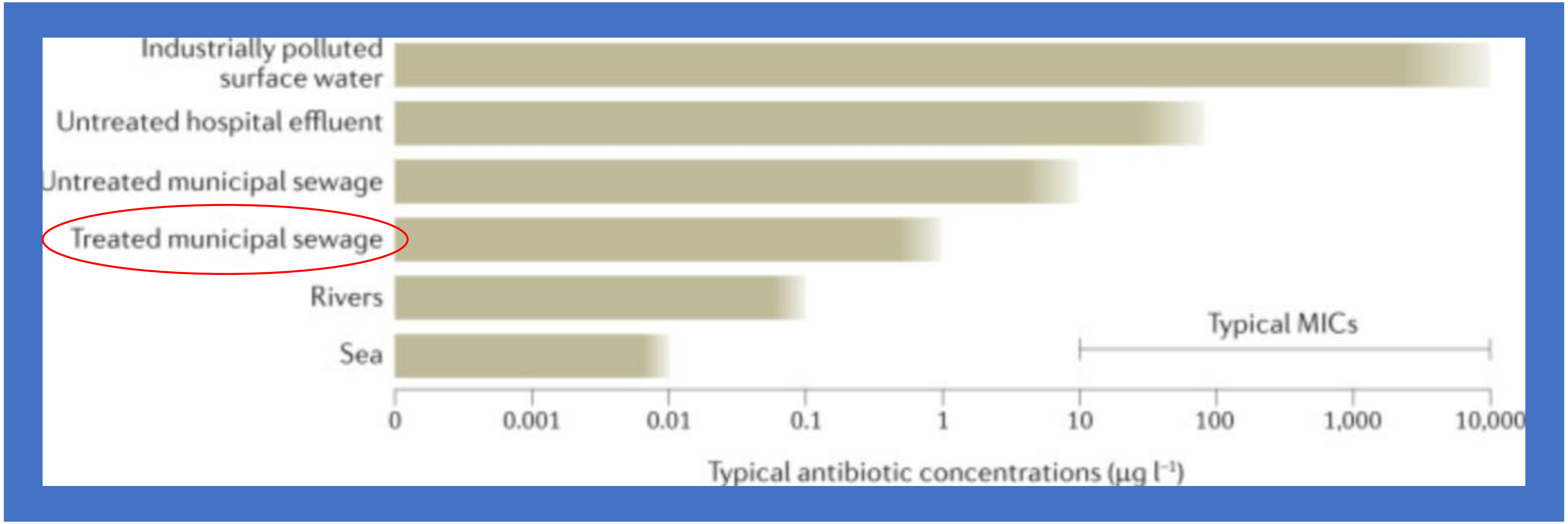
- researchers from the [Ineos Oxford Institute for antimicrobial research (IOI)] revealed fruit flies in Nigeria hospital carrying 17 different species of bacteria, including Staphylococcus aureus, a common cause of hospital-acquired infections.
  - a large portion having genes linked to AMR.
- "Flies are coprophagic – they eat faeces, they eat manure. Those who have an infection pass it in the faeces, the flies take it up and can perch on the hospital surfaces or even on food, on environments that people touch – so that could be a factor [in the spread of infection]."
- the findings "imply that flies circulating in hospital wards could pose a threat to patients who are vulnerable to infection during their stay, especially as flies commonly land on patients

Flies in hospital wards may be spreading drug-resistant bacteria to patients

Scientists in Nigeria found the insects carry infections resistant to last-resort antibiotics, adding to fears about superbugs

Lay K. Flies in hospital wards may be spreading drug-resistant bacteria to patients. *The Guardian*. Published February 5, 2025.
https://www.theguardian.com/global-development/2025/feb/05/flies-in-hospital-wards-may-be-spreading-drug-resistant-bacteria-to-patients

(6) AMR: Water Systems



antibiotic concentrations in selected aquatic environments

Larsson DGJ, Flach CF. Nat Rev Microbiol. 2022;20(5):257-269.

AMR: Water Systems

"The bacteria we found may originate from many sources, from patients, medical personnel, and even the environment surrounding the hospital. Once established in **sink drains**, they can spread outwards, posing significant risks to immunocompromised patients above all."

Of the species found here, *Klebsiella, Enterobacter*, and *Pseudo. aeruginosa* feature among the so-called **ESKAPE** group of bacteria (+ Enterococcus faecium, Staph. aureus. Acinetobacter baumannii), known to thrive in hospital settings and to show frequent multi-resistance and a high potential for causing illness.

AMR global threats
– WHO & CDC

RESEARCHERS focused on sink drains in a single modern university hospital on the island of Majorca, built in 2001

SciTechDaily. Hidden epidemic: drug-resistant bacteria in hospital plumbing. 2025. https://scitechdaily.com/hidden-epidemic-drug-resistant-bacteria-are-spreading-through-hospital-plumbing/

(7) AMR: Environmental Toxins

- glyphosate, other herbicides & fungicides
- artificial sweeteners: sucralose, saccharin, aspartame
- microplastics
- heavy metals

Zhu S, et al. Ecotoxicol Environ Saf. Published online June 14, 2023.
Joshi T. Climate change and antimicrobial resistance. Univ Plymouth. 2019.
https://www.plymouth.ac.uk/news/pr-opinion/global-challenges-intertwined-how-climate-change-is-linked-to-antimicrobial-resistance

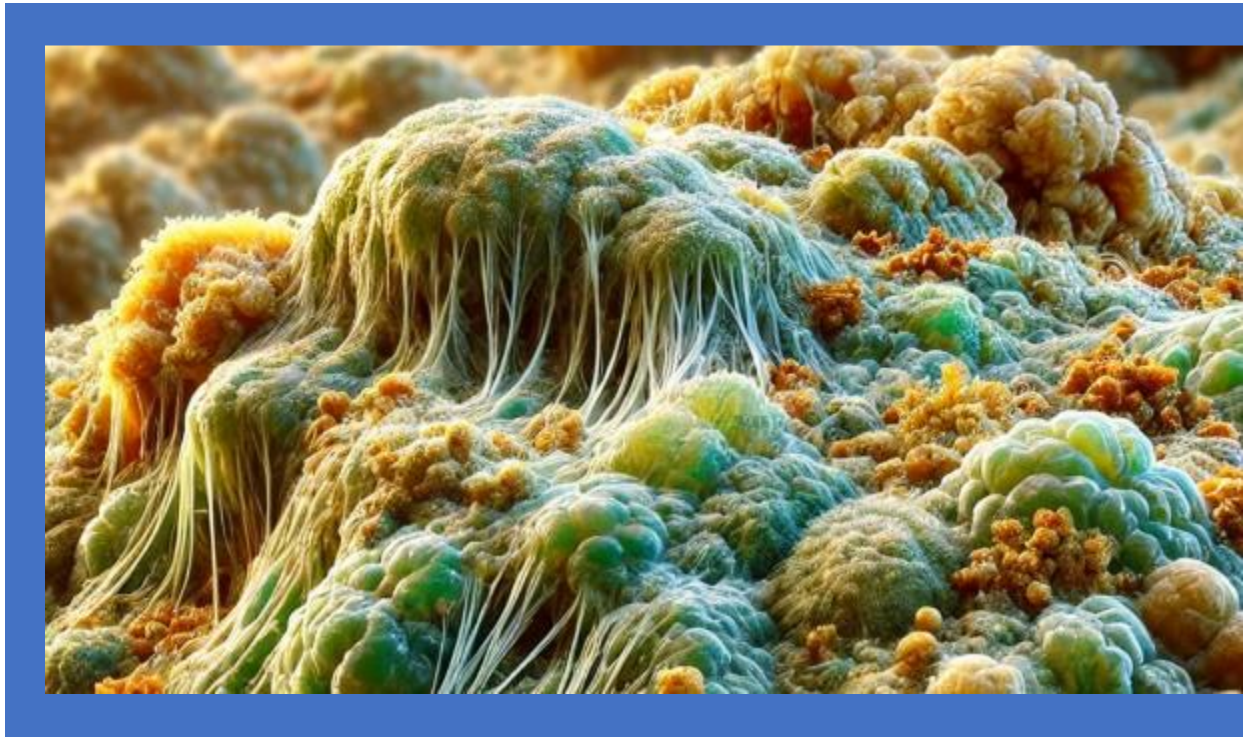
(8) AMR: Pharmaceutical Rx

paclitaxel docetaxel acetaminophen ibuprofen naproxen diclofenac	propranolol fluoxetine sertraline bupropion escitalopram

Zhu S, et al. Ecotoxicol Environ Saf. Published online June 14, 2023.

(9) AMR: Biofilms

Biofilms are a major contributor to infections (65%) and antibiotic failure



increased temperatures may select for biofilm formation

de la Fuente-Nunez C, et al. Drug Resist Updat. 2023;71:101012.

Agenda

1. <u>Climate Medicine</u>: Definition & Relevance to AMR
2. <u>AMR</u>: Definition, Key Stats & MoA
3. <u>AMR</u>: Causal Factors
4. **<u>Solutions</u>: Current Strategies**

AMR: Strategies

"Minimizing resistance should … be considered comprehensively, by resistance mechanism, microorganism, antimicrobial drug, host, and context; … broad ranging, multidisciplinary research is needed across these … levels, interlinked across the health-care, agriculture, and environment sectors.

Intelligent, integrated approaches, mindful of potential unintended results, are needed to ensure sustained, worldwide access to effective antimicrobials."

https://courses.edx.org/c4x/KIx/KIGlobalHx/asset/Lancet_2.pdf

AMR: Antibiotic Use Stewardship

Antibiotic use is considered the most important driver of antimicrobial resistance.

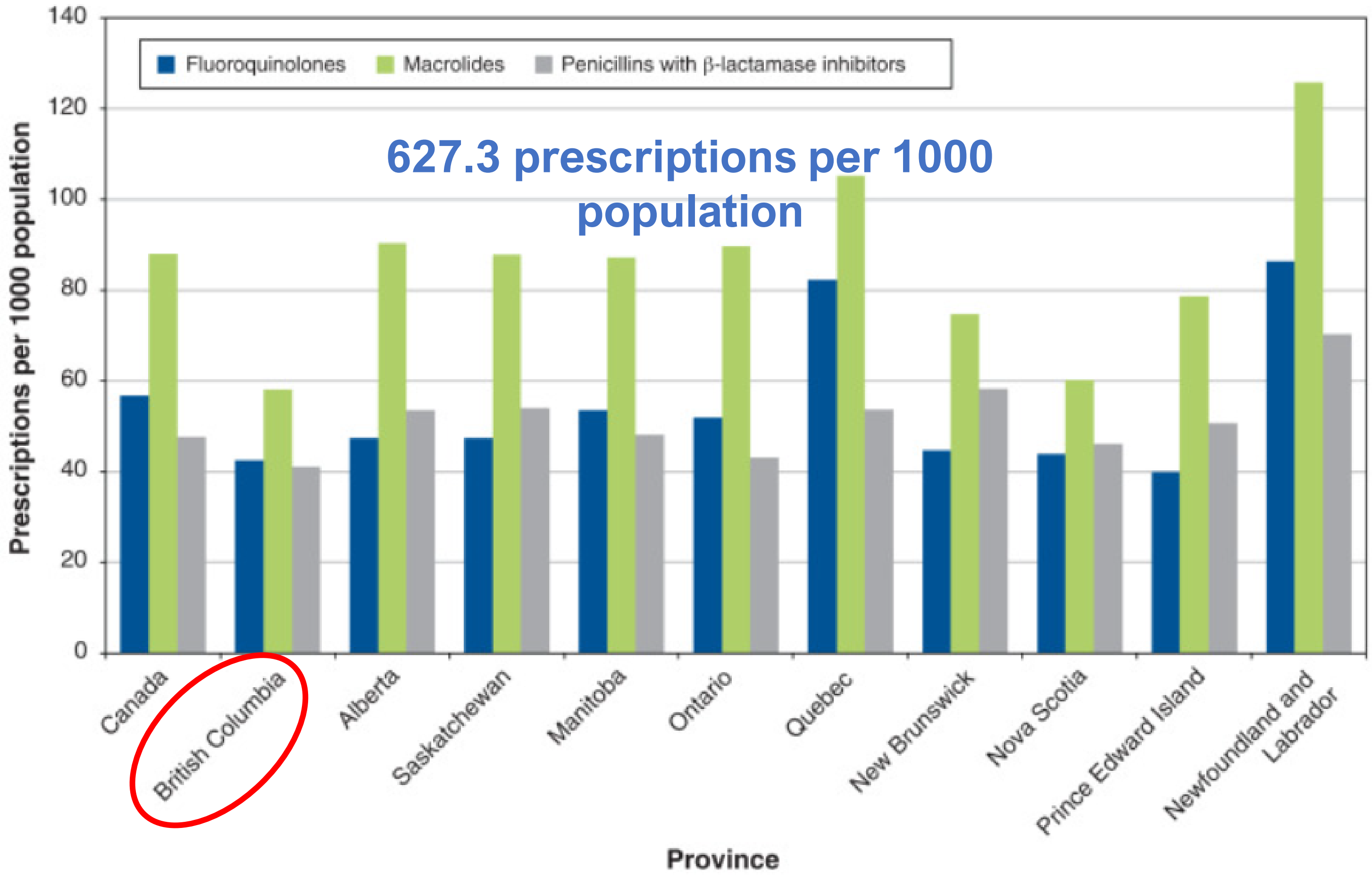
World Antibiotic Awareness Week (WAAW), led by the WHO, is held every November since 2015.

WAAW aims to increase global awareness of antibiotic resistance and to encourage best practice among the general public, health workers and policy makers to limit the development and distribution of drug resistance.

Mendelson M, et al. Lancet. 2015;386(10005):1761–1773.
Laxminarayan R, et al. Lancet Infect Dis. 2018;18(5):e1–e9.

AMR: Antibiotic Use Stewardship

BC's provincially funded stewardship programs, in place since 2005, have led to a substantial reduction in antibiotic use.



Crosby M, et al. CMAJ Open. 2022 Mar 22;10(1):E262-E268.

AMR: Strategies – Novel Antimicrobials

Adopting the response framework of *When Antibiotics Fail*, the first pillar of the Pan-Canadian Action Plan on Antimicrobial Resistance, "Research and Innovation," focuses on a need for novel antimicrobials. The action plan's first desired outcome is the development of "economic and/or regulatory incentives to support innovation and facilitate sustainable access to new and existing antimicrobials, diagnostics, and alternatives to antimicrobials," a response highlighted in the CCA's report.

https://www.canada.ca/en/public-health/services/publications/drugs-health-products/pan-canadian-action-plan-antimicrobial-resistance.html#message

AMR: Strategies – Novel Antimicrobials

What Alternative Options are Available?

Candaclear Four

25 Billion

CFU of probiotic organisms per strip combined with garlic and cinnamon

Contains the same
4 broadly studied strains

EACH DELAYED RELEASE ALLICIN TABLET CONTAINS:
Garlic (*Allium sativum*) Bulb
(providing 10 mg thiosulfinates and 4.5 mg allicin) . . . . . 500 mg

EACH ALLICIN WITH CINNAMON CAPSULE CONTAINS:
Garlic (*Allium sativum*) Bulb
(providing 10 mg thiosulfinates and 4.5 mg allicin) . . . . . 500 mg
Cinnamon (*Cinnamomum verum*) Bark Oil
(providing 40 mg cinnamaldehyde) . . . . . 66 mg
Cinnamon (*Cinnamomum verum*) Bark . . . . . 30 mg

EACH ALLICIN WITH CAPRYLATES CAPSULE CONTAINS:
Garlic (*Allium sativum*) Bulb
(providing 4 mg thiosulfinates and 1.8 mg allicin) . . . . . 200 mg
Cinnamon (*Cinnamomum verum*) Bark Oil
(providing 20 mg cinnamaldehyde) . . . . . 33 mg
Non-Medicinal Ingredients:
Magnesium caprylate . . . . . 200 mg
Calcium caprylate . . . . . 100 mg

EACH PROBIOTIC WITH NUTRIENTS CAPSULE CONTAINS:
Probiotic Consortium . . . . . 25 billion CFU
Lactobacillus acidophilus (CUL-60)
Lactobacillus acidophilus (CUL-21)
Bifidobacterium bifidum (CUL-20)
Bifidobacterium animalis subsp. *lactis* (CUL-34)
L-Glutamine . . . . . 400 mg
N-Acetyl Glucosamine (from exoskeleton of shrimp / crab) . . . . . 200 mg
Beta-carotene . . . . . 2 mg

Hussein AQ, Al-Meani SAL, *et al*. J Popul Ther Clin Pharmacol. 2023;30(2):e375-e392.
Lopes SP, Fortuna Rodrigues C, *et al*. Antibiotics (Basel). 2024;13(12):1232.
Mohsenipour Z, Hassanshahian M, *et al*. Jundishapur J Microbiol. 2015;8(8):e48733.
Chen B, Al-Dhabi NA, *et al*. Saudi J Biol Sci. 2020;27(6):1428-1434.

Candicin

A unique blend of essential oils for relief of digestive upset

Dairy Free · Gluten Free · Non GMO · Vegan · Soy Free

EACH CAPSULE CONTAINS/ CHAQUE CAPSULE CONTIENT:

Oregano Flowering Tops Essential Oil
Std. Extract (70% Carvacrol)/
Extrait normalisé de huile essentielle de sommité en fleurs d'origan
(*Origanum vulgare*) (70 % de carvacrol) .... 95 mg

Clove Leaf Essential Oil/
Huile essentielle de feuille de girofle
(*Syzygium aromaticum*) .... 45 mg

Ginger Root Essential Oil/
Huile essentielle de racine de gingembre
(*Zingiber officinale*) .... 45 mg

Wormwood Leaf Essential Oil/
Huile essentielle de feuille d'absinthe
(*Artemisia absinthium*) .... 45 mg

Evening Primrose Seed Oil/
Huile de graines d'onagre (*Oenothera biennis*) .... 20 mg

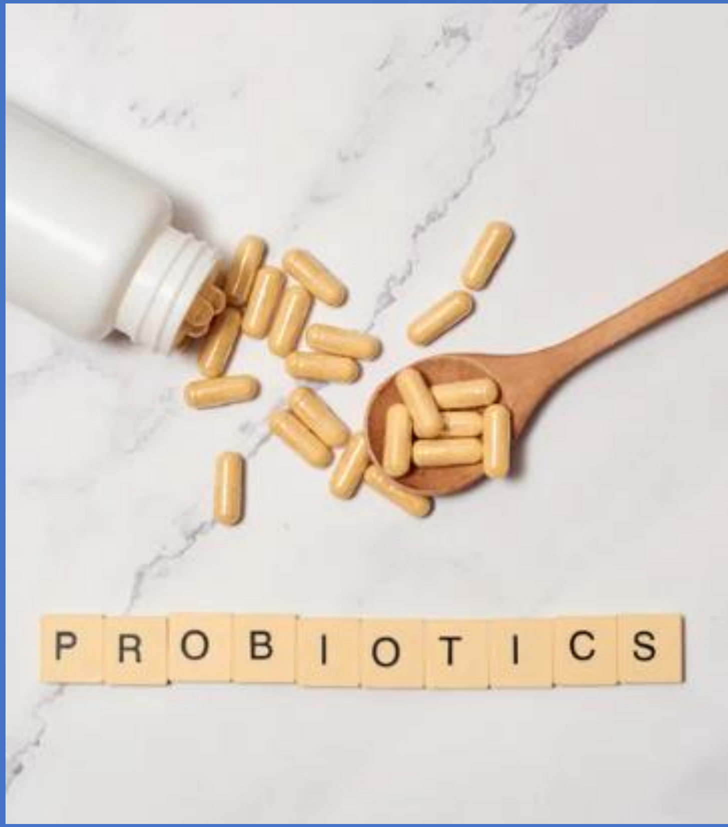
Anti-Microbials

Oregano Flowering Tops Essential Oil	Antibacterial, (H. Pylori), antifungal, anti-inflammatory, decreases biofilm formation by Candida and an antioxidant
Clove Leaf Essential Oil	Antibacterial, antiviral and antinociceptive (decreases pain), decreases biofilm formation
Ginger Root Essential Oil	Antioxidant, anti-inflammatory, antimicrobial, antinausea, and antiemetic
Wormwood Leaf Essential Oil	Antioxidant, antimicrobial, and antiparasitic
Evening Primrose Seed Oil	Protects the gastric mucosa against injuries caused by NSAID (Aspirin)

Hacioglu M, et al. 2021;76(11-12):443–450. doi:10.1515/znc-2021-0002.
Yuan Y, et al. BMC Complement Med Ther. 2023 Feb 21;23(1):61.
Hofmeisterová L, et al. *Antibiotics*. 2024;13(12):1232. doi:10.3390/antibiotics13121232.

AMR: Strategies - Probiotics

Along with helping to restore a healthy gut microbiome and enhance immune function, probiotics are leading the pack in AMR intervention strategies!



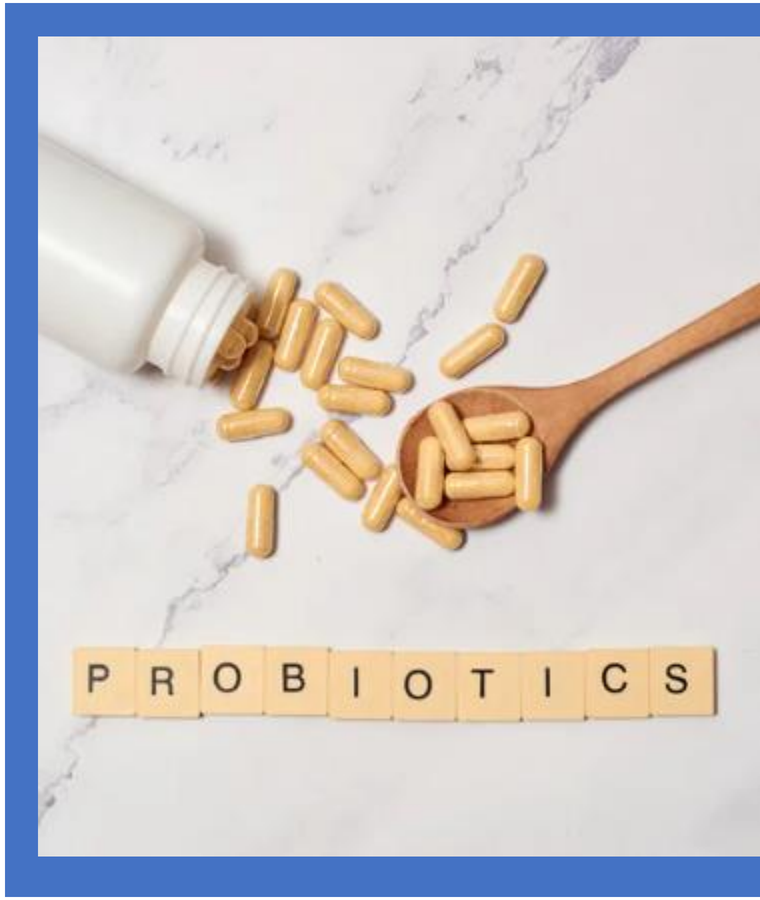
Plummer et al 2005, Int J Antimicrob Agents 26; 69-74
John D, et al. Front Microbiomes. 2024;3:1359580.

AMR: Strategies - Probiotics

compete pathogenic microbes

lower antibiotic use

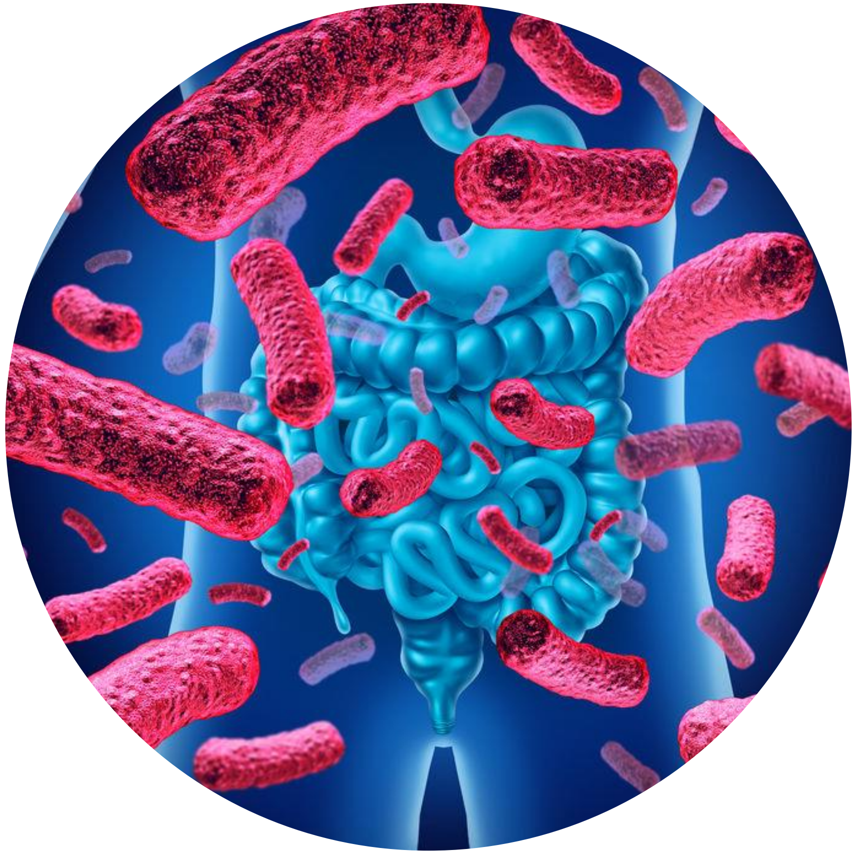
decrease AMR in gut microbiome



Plummer et al 2005, Int J Antimicrob Agents 26; 69-74
John D, et al. Front Microbiomes. 2024;3:1359580.

The Cambridge Antibiotic Probiotic Trials:

1) C. difficile trial
2) Trial 1 – opportunistic regrowth
3) Trial 2 – antibiotic resistance



(1) The Cambridge Probiotic Clostridium difficile Trial

AIM: Efficacy of probiotics to prevent or reduce *Clostridium difficile* infection and associated diarrhoea in patients receiving antibiotics.

TRIAL DESIGN:

- Randomised, double blind, placebo-controlled study
- 138 patients initiating antibiotic therapy were randomly assigned to take daily either 25 billion probiotic consortium or placebo for 20 days with faecal samples taken at day 0 and 20

- Incidence of the following were monitored:
  1. Presence of *C.difficile*
  2. Presence of *C.difficile* toxin
  3. Incidence of *C.difficile* diarrhoea

Plummer et al. Int Microbiol. 2004;7(1):59-62.

(1) The Cambridge Probiotic Clostridium difficile Trial - Results

1. Incidence of *C.difficile*:

Placebo: 13.0%

Probiotics: 15.9%

2. Incidence of *C.difficile* toxin:

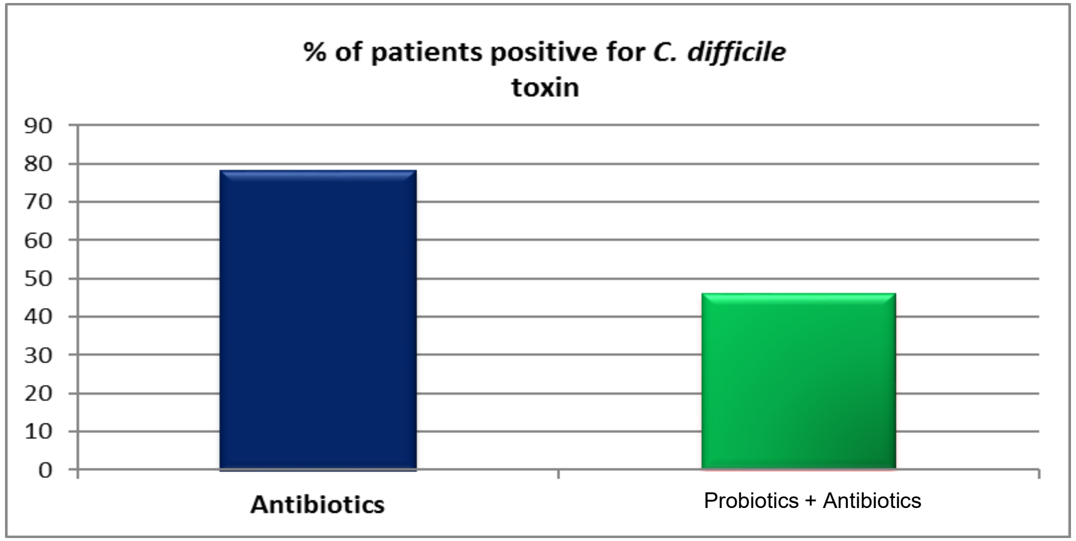
Placebo: 78% of positives

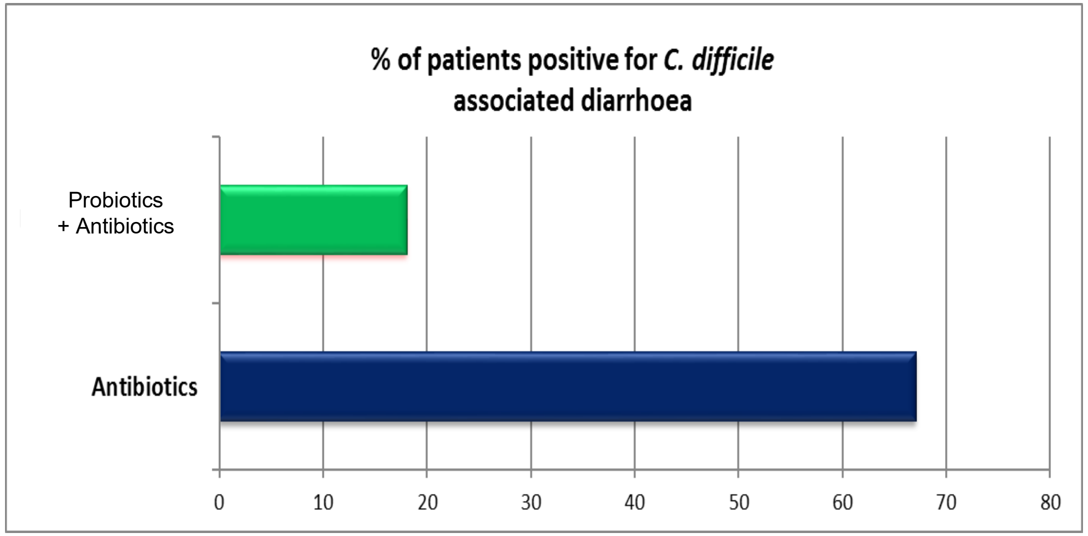
Probiotics: 46% of positives

3. Development of *C.difficile* associated diarrhoea:

Placebo: 67% of positives

Probiotics: 18% of positives





(2) The Cambridge Probiotic Antibiotic Trial 1

Opportunistic Re-growth of Pathogens Following Antibiotic Therapy

Aim:

- To investigate the effect of antibiotics on re-growth of opportunistic pathogens
- To investigate the effect of the probiotic consortium on this opportunistic pathogen re-growth

Trial Design:

	Treatment	Period (days)
antibiotics ONLY	Antibiotics + Placebo	1 - 7
	Placebo	8 - 15
probiotics AFTER	Antibiotics + Placebo	1 - 7
	25 billion Probiotic Consortium	8 - 15
probiotics ALONG WITH	Antibiotics + 25 billion Probiotic Consortium	1 - 7
	25 billion Probiotic Consortium	8 - 15

Fecal sample collection: Days 1 (control), 7, 12, 17 and 27

Opportunistic pathogens measured:

- Total facultative anaerobes
- Enterobacteria - Kleb. pneumoniae, E.coli
- Enterococci – faecium, faecalis
- Staphylococci

ESKAPE
AMR global threats
WHO & CDC

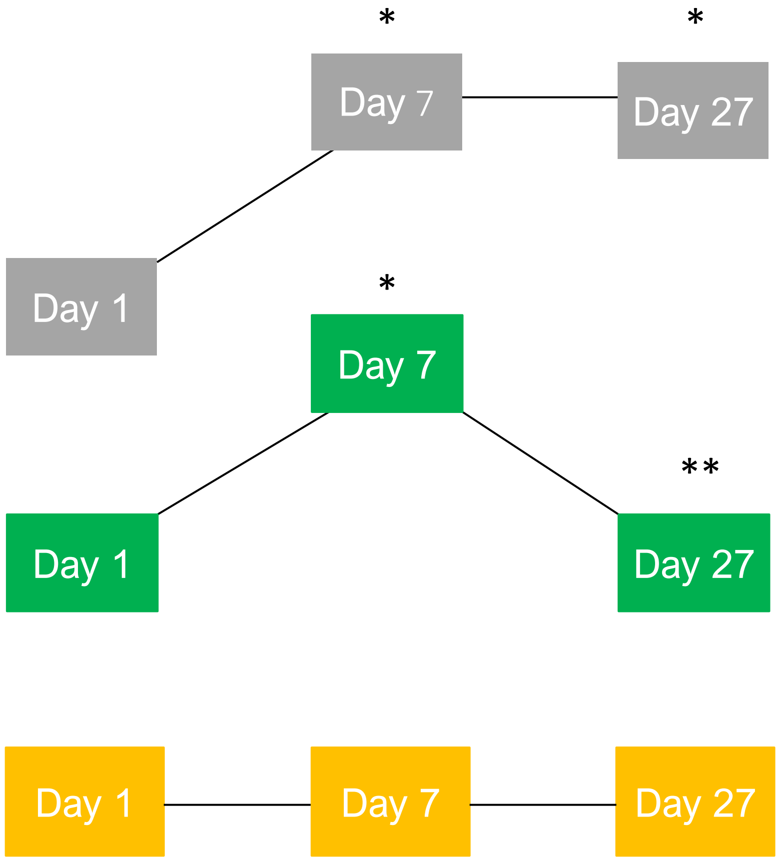
Madden et al 2005, Int Immunopharm 5; 1091-97

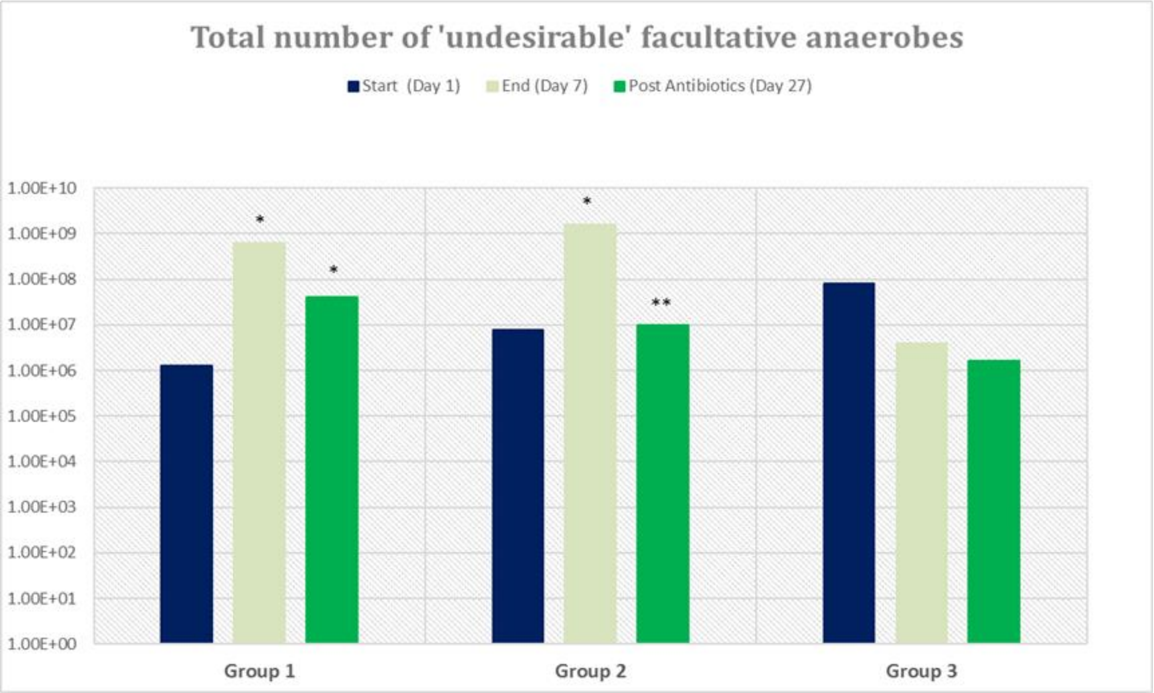
(2) The Cambridge Probiotic Antibiotic Trial 1 - Results

Antibiotic/ Placebo

Antibiotic
followed by probiotic consortium

Antibiotic with and followed by probiotic consortium





No overgrowth happened AT ALL!

Madden et al 2005, Int Immunopharm 5; 1091-97

(3) The Cambridge Probiotic Antibiotic Trial 2

Antibiotic Resistance in the Re-growth Microbiota

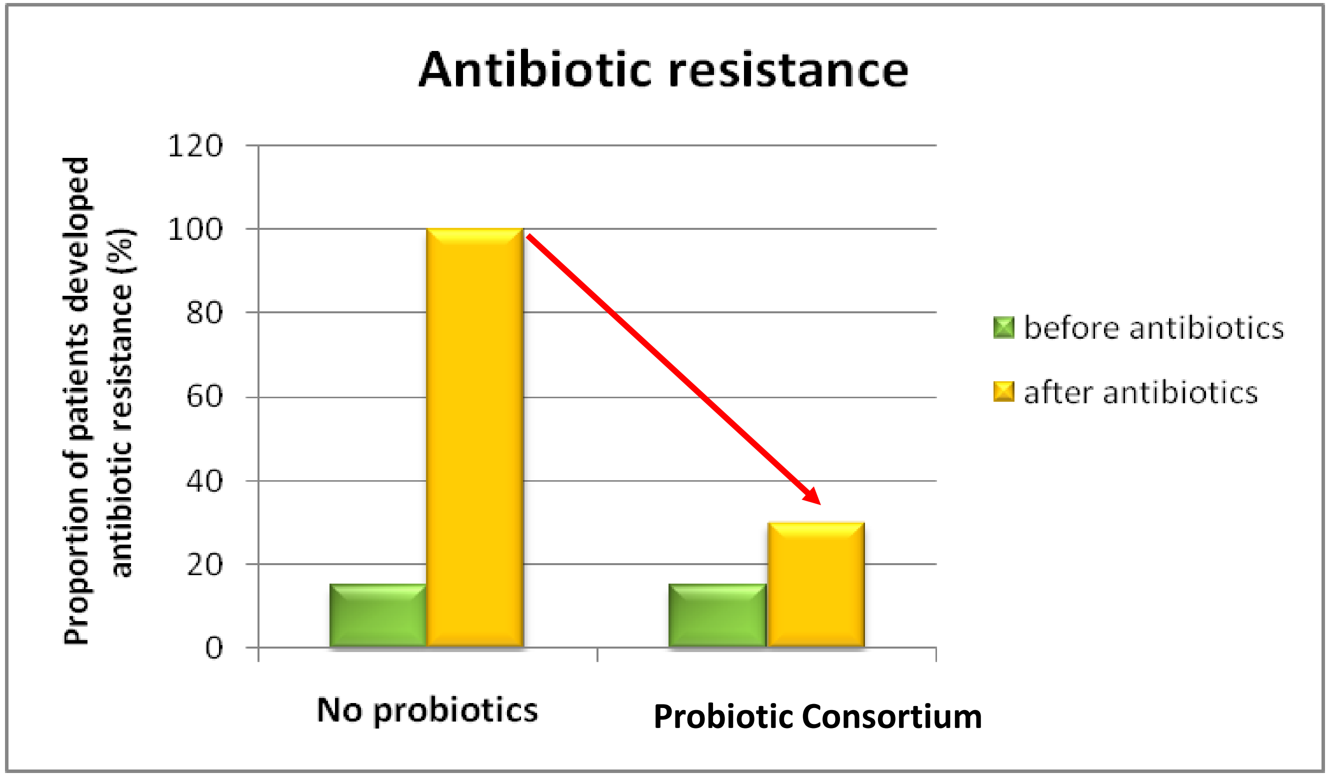
AIM: The effect of the probiotic consortium on the antibiotic resistance in the re-growth gut microbiota following antibiotic therapy.

TRIAL DESIGN:

- Randomised, double blind, placebo-controlled study
- 155 patients requiring antibiotic therapy were randomly assigned to ***take daily either 25 billion probiotic consortium or placebo for 21 days in conjunction with antibiotics***
- Fecal sample collection: day 1 (start), day 7 (the end of antibiotic treatment) and day 35 (4 weeks post antibiotic treatment)
- Gut microbiota disruption and antibiotic resistance were investigated

Plummer et al 2005, Int J Antimicrob Agents 26; 69-74

(3) The Cambridge Probiotic Antibiotic Trial 2 - Results



- The types measured were the Enterococci
- At the start, about 18% of patients had detectable levels of antibiotic resistant Enterococci.
- After the trial, the control group 100% of patients developed detectable levels of antibiotic resistant Enterococci, whereas only 30% of the probiotic group had detectable levels of antibiotic resistant Enterococci

Plummer et al 2005, Int J Antimicrob Agents 26; 69-74

HMF Intensive / HMF IBS Relief

25 Billion

CFU per capsule formulation of Genestra HMF Probiotics

Consisting the same **4 core strains included in the most broadly studied consortium**

EACH CAPSULE CONTAINS/ CHAQUE CAPSULE CONTIENT:

Probiotic Consortium/ Consortium probiotique .... 25 billion CFU/ milliards d'UFC

Lactobacillus acidophilus (CUL-60 & CUL-21) .... 19 billion CFU / milliards d'UFC

Bifidobacterium animalis subsp. *lactis* (CUL-34)
& *Bifidobacterium bifidum* (CUL-20) .... 6 billion CFU / milliards d'UFC

Effective formulation for IBS symptom relief (adults and children 11 years and older)
Perfect for anyone requiring a daily therapeutic dose, and/or who may be sensitive to fructooligosaccharides (FOS).

HMF Antibiotic Care

EACH CAPSULE CONTAINS:

Probiotic Consortium	100 billion CFU
Lactobacillus acidophilus (CUL-60 & CUL-21)	50 billion CFU
Bifidobacterium animalis subsp. *lactis* (CUL-34) & *Bifidobacterium bifidum* (CUL-20)	25 billion CFU
Lactobacillus salivarius (CUL-61)	25 billion CFU

Provides **100 billion CFU per capsule of** Genestra HMF probiotic organisms, to support and optimize care associated with antibiotic usage

Use while taking antibiotics, and continue for 14 days post antibiotic use to maximize the benefit of supplementation; then transition to a maintenance formulation

As with all probiotics, use 2-3 hours away from antibiotics

Contains a small quantity of Fructooligosaccharides (FOS)

Clinically proven to effectively supplement the normal intestinal microbiota following antibiotic therapy

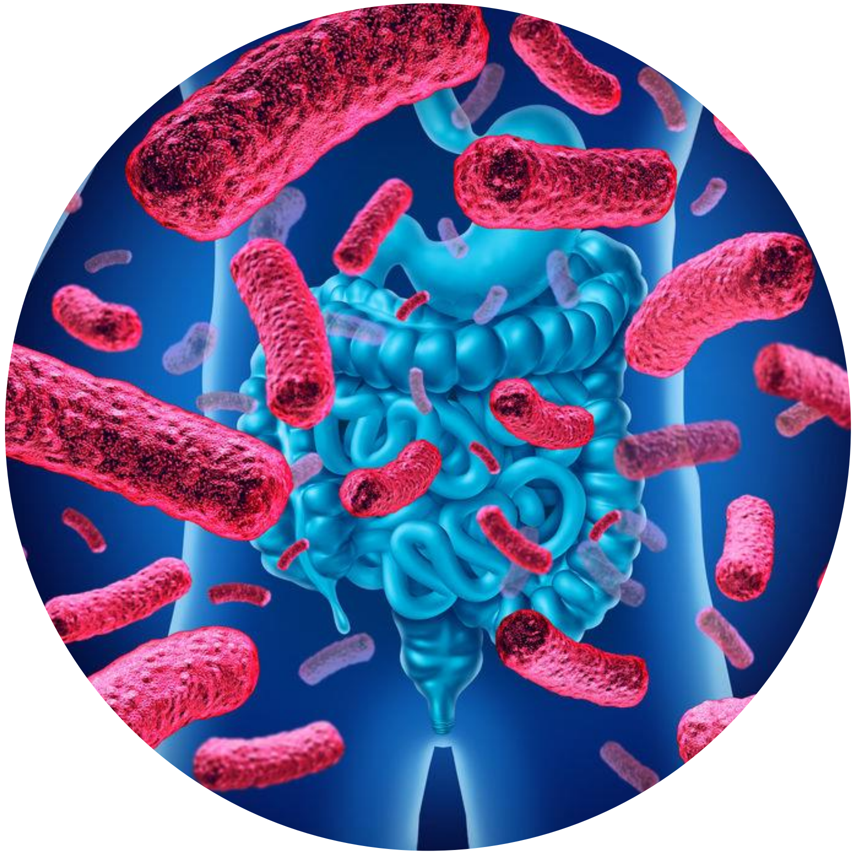
Provides a higher potency than the 25 billion CFU therapeutic dose of the same organisms utilized in the 2 clinical trials* relating to probiotics delivering superior care and support during and after antibiotic use

Madden, et al. *Int Immunopharmacol*. 2005

Plummer, et al. *Int J Antimicrob Agents*. 2005

The FANTIB Study

- Antibiotic resistant genes

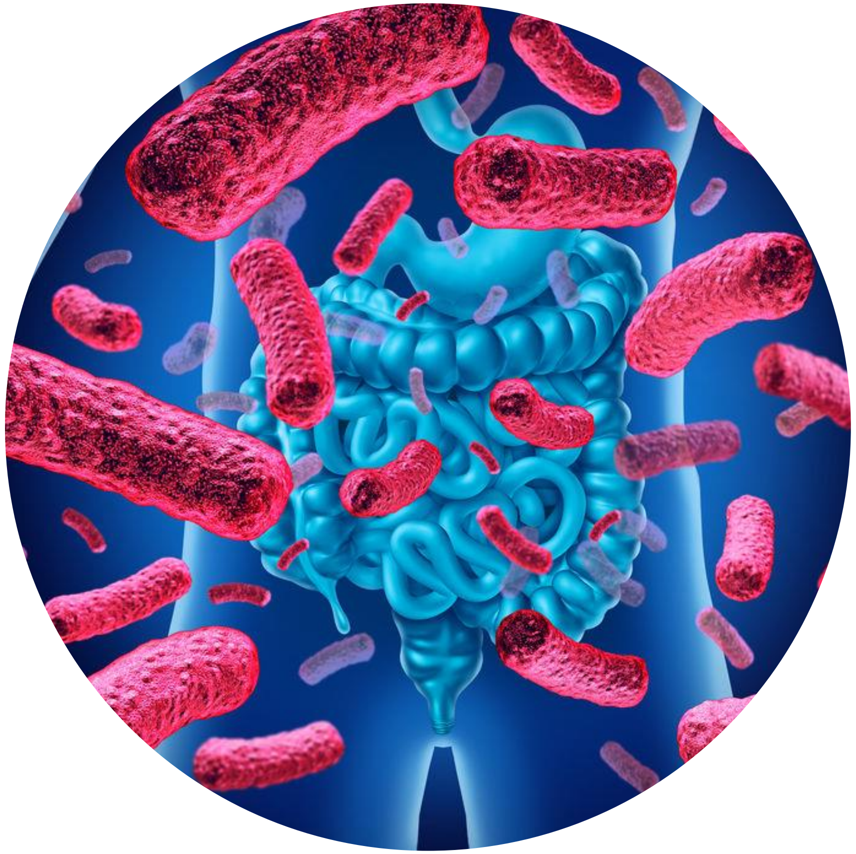


The FANTIB Study

Antibiotics +/- Probiotics

↓

?? ARG : Antibiotic Resistant Genes



The Fantib Study

THE FANTIB STUDY
T- Probiotic Consortium - 35 BILLION CFU

Lactobacillus acidophilus	CUL60	*
Lactobacillus acidophilus	CUL21	*
Bifidobacterium bifidum	CUL20	*
Bifidobacterium animalis sbsp. Lactis	CUL34	*
Saccharamyces boulardii	CNCM-1-1079	

Objective of the Double-blind Placebo Controlled Study:
To demonstrate if co-administration of probiotics alongside antibiotics can reduce antibiotic resistance

Design of the study:

50 Adults receiving antibiotics for 5 to 10 days with or without probiotic supplementation of **T-Probiotic Consortium for 10 days**.

Administration of **35 billion CFU of proprietary human probiotic consortium daily**

Duration and intervention:
10 days long.

Samples were taken prior to the study, with follow-up on day 10 and day 30 (20 days after the last administration)

Follow up:
Microbial DNA was extracted from all 150 faecal samples. These samples underwent Shotgun metagenomic sequencing.

Shotgun sequencing allows:
- Identification and visualization of microbial diversity
- Quantification of total levels of antibiotic-resistant genes (ARG's), and resistance to individual antibiotic types

John et al. 2024 *

The Fantib Study

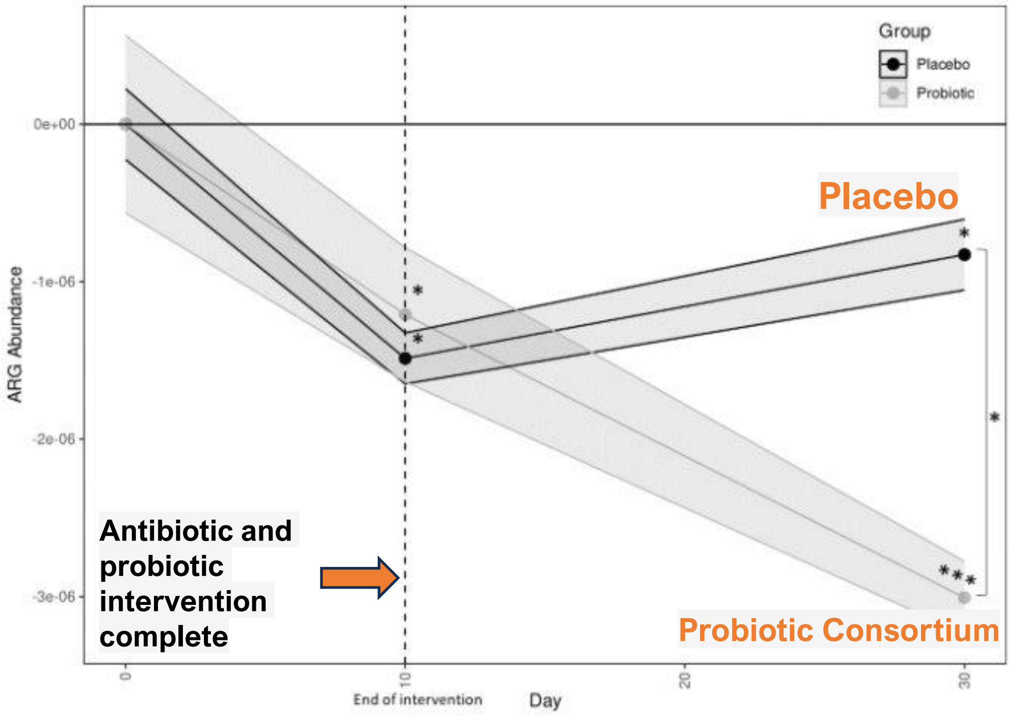
THE FANTIB STUDY
T-Probiotic Consortium - 35 BILLION CFU

Lactobacillus acidophilus CUL60 *
Lactobacillus acidophilus CUL21 *
Bifidobacterium bifidum CUL20 *
Bifidobacterium animalis sbsp. Lactis CUL34 *
Saccharamyces boulardii CNCM-1-1079

Objective of the Double-blind Placebo Controlled Study:

To demonstrate if co-administration of probiotics alongside antibiotics can reduce antibiotic resistance

Outcome of the study:



		Placebo (n=25)	Probiotic (n=25)
Antibiotic Class			
	β-Lactams	13 (52%)	14 (56%)
	Macrolides	12 (48%)	11 (44%)
Antibiotic			
	Amoxicillin	5 (20%)	5 (20%)
	Cephalosporins	8 (32%)	9 (36%)
	Azithromycin	5 (20%)	7 (28%)
	Clarithromycin	6 (24%)	3 (12%)
	Clindamycin	0 (0%)	1 (4%)
	Spiramycin	1 (4%)	0 (0%)
Length (Days)			
	5	15 (60%)	14 (56%)
	6	4 (16%)	3 (12%)
	7	5 (20%)	6 (24%)
	8	0 (0%)	1 (4%)
	9	0 (0%)	0 (0%)
	10	1 (4%)	1 (4%)

Levels of antibiotic-resistant organisms increased in the placebo group but decreased in the probiotic group

Demonstrated that **use of proprietary T-Probiotic Consortium alongside antibiotics significantly reduced total antibiotic resistance**

This effect was clear at 30 days (20 days after final intervention), and so is likely to be a PERMANENT effect

John et al. 2024 *

HMF Travel

Overview

HMF® Travel combines five probiotic strains to support gastrointestinal health when travelling. The shelf-stable convenient capsule format is ideal for your vacation!

Benefits

- 35 billion CFU per day in a shelf-stable format
- Helps to reduce the risk of traveller's diarrhoea and occasional diarrhoea*
- Includes *Saccharomyces boulardii* plus four proprietary probiotic strains
- Potency guaranteed through expiration

Non GMO | Gluten Free | Soy Free | Dairy Free | No FOS | Vegan

Medicinal Ingredients

EACH TABLET CONTAINS:

Probiotic Consortium..17.5 billion CFU
Lactobacillus acidophilus (CUL-60 & Cul-21)..............................9.375 billion CFU
Saccharomyces boulardii (CNCM-I-1079).......................................5 billion CFU
Bifidobacterium animalis subsp. Lactis (CUL-34)
& Bifidobacterium bifidum (CUL-20)..3.125 billion CFU

*Antibiotic-associated diarrhoea

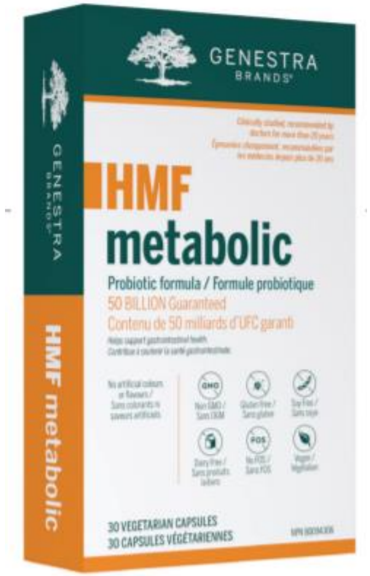
Ensure Strains from Study Match Strains in Product

Michael DR. Bacteria help for healthier hearts. Advances Wales 2016; 79: 14

A collaborative study between Cardiff University and Cultech Ltd has found that friendly bacteria can play a role in helping to prevent high blood cholesterol levels, and support current treatment programmes for heart disease. This study used cell-based experimental models to identify a strain of friendly bacteria that may be able to help lower blood cholesterol levels. The presence of *Lactobacillus plantarum* CUL66 could alter the behaviour of the major cholesterol absorbing cells of the intestines and reduce their ability to transport cholesterol.

Lactobacillus plantarum **CUL 66**

Species — Strain



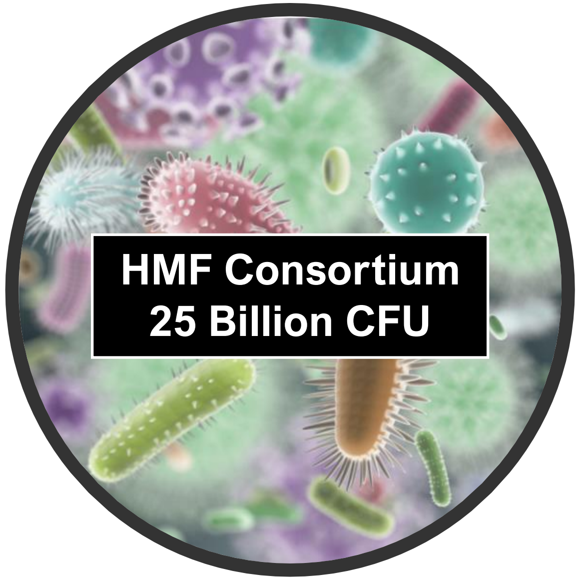
EACH CAPSULE CONTAINS:

Probiotic Consortium	50 billion CFU
Lactobacillus acidophilus (CUL-60 & CUL-21)	25.2 billion CFU
Lactobacillus plantarum (CUL-66)	16.5 billion CFU
Bifidobacterium animalis subsp. lactis (CUL-34) & *Bifidobacterium bifidum* (CUL-20)	8.3 billion CFU

Non-Medicinal Ingredients: Cellulose, hypromellose, sunflower lecithin, silica

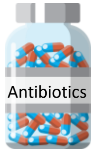
HMF Consortium – 25 Billion CFU

The most broadly studied multi strain probiotic consortium in the world!



Athletic Performance
In endurance athletes

Coughs and Colds
In children



Antibiotic Resistance

Immune Function
In adults

Intestinal Permeability
In healthy adults

IBS
In IBS sufferers and athletes

Diarrhea
Antibiotic associated

Anxiety
In healthy adults

Cognitive Function
In healthy adults

World Naturopathic Federation

Anti-Microbial Resistance (AMR) Committee

Committee is currently finalizing an overhaul of the AMR Website
https://www.wnf-amr.org

Creating an Evidence Map for AMR

NHSc's Sponsorship is helping to fund the committee's activities

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pure encapsulations®

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GENESTRA BRANDS®

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Promotion Dates: September 15 - October 13

UP TO 15% OFF¥

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Prepare for the season with our Fall Promotion!
Get **15% off** on select products when you purchase **48 units or more** using the code **FALL152025**. Less than 48 units? Use code **FALL102025** and receive **10% off**.

Promotion Dates: September 15 - October 13

Upcoming Webinars

Top Versatile Ingredients to Deliver Comprehensive Care while Minimizing Pill Burden

Presented by: **Dr. Penny Kendall-Reed, ND**

Wednesday, October 22nd, 2025

8:00 – 9:30 PM EST/ 5:00 – 6:00 PM PST

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RESEARCH: Antibiotic Therapy & Probiotics (Clinical Trials)

Clinical Study	Problem	Population	Results	Probiotics Used
Cambridge IBS Study	**Antibiotic Changes to Microbiota**	**Antibiotic therapy use in IBS patients**	• **Antibiotic use significantly altered microbiota** • Probiotic supplementation helped to decrease the overgrowth of opportunistic populations • **Reduced yeast growth** by day 14 when probiotic supplementation prior + alongside antibiotic therapy	**Core 4 Strains** **…25 billion CFU**
Cambridge Probiotic/Antibiotic Trial 1	**Antibiotic Changes to Microbiota**	**Antibiotic therapy use for *Helicobacter pylori***	• During and following antibiotic use see overgrowth of undesirable and potentially harmful microbiota • Post antibiotic use, **probiotic supplementation lowered undesirable microbiota** • Use of probiotics alongside antibiotic helped stabilize microbiota	**Core 4 Strains** **…25 billion CFU**
Cambridge Probiotic/Antibiotic Trial 2	**Antibiotic Changes to Microbiota**	**Antibiotic therapy use in adults**	• Antibiotic use increased presence of antibiotic-resistant microbes • Probiotic supplementation - Reduced gut microbiota disruption - **Reduced levels of antibiotic-resistance microbes**	**Core 4 Strains** **…25 billion CFU**
Antibiotics and Gut Microbiome Study	**Antibiotic Changes to Microbiota**	**Antibiotic therapy use in adults**	• Antibiotic use led overgrowth of undesirable microbiota + antibiotic-resistance in regrowth bacteria • Reduced microbiota changes seen with probiotic use during antibiotic therapy • Probiotic use **significantly reduced level of antibiotic resistance in re-growth bacteria**	**Core 4 Strains + *S. boulardii*** **…35 billion CFU**

GENESTRA BRANDS®

HMF Probiotics: Use Alongside Antibiotics

	HMF Travel	HMF Intensive	HMF Antibiotic Care
Formula	**35 Billion CFUs/dose*** • 4 Core Strains…12.5 billion CFUs + • *Sacchromyces boulardii*… 5 Billion CFUs *2 capsules per dose	**25 Billion CFUs/dose** • 4 Core Strains… 25 billion CFUs	**100 Billion CFUs/dose** • 4 Core Strains…75 billion CFUs + • *Ligilactobacillus salivarius* (CUL-61) … 25 billion CFUs + • FOS
Use	*Support gastrointestinal health, promotes favorable gut flora*	*Decrease microbiota disruption with antibiotic use*	*During and post-antibiotic care*
Research	Clinically proven* formulation demonstrated **to reduce the level of antibiotic-resistance** in the growth microbial population after antibiotic therapy. • Minimized the disruption of antibiotics on gut microbiota by preserving microbial diversity **Neurogastroenterol Motil. 2024 Apr;36(4):e14751*	Clinically proven* formulation demonstrated to supplement the normal intestinal microbiota following **antibiotic therapy.** • Probiotic supplementation helped to decrease the overgrowth of potentially harmful populations. • Preserved helpful Lactobacillus bacteria populations • Reduced level of antibiotic-resistant bacteria **Int Immunopharmacol. 2005 Jun;5(6):1091-7.* **Int J Antimicrob Agents 2005; 26(1):69-74.* **Plumber et al. Microbiota of Irritable Bowel Syndrome*	Studies* demonstrate strains included in this probiotic improved intestinal microflora response to negative effects of antibiotic therapy, including: • Preventing overgrowth of potentially harmful populations • Preserved helpful Lactobacillus bacteria populations • Reduced level of antibiotic-resistant bacteria **Int Immunopharmacol. 2005 Jun;5(6):1091-7.*
Clinical Trials *(on this formulation)*	• **Antibiotics and Gut Microbiome Study**	• **Cambridge Probiotic/Antibiotic Trial** • **Cambridge Probiotic/Antibiotic Trial 2** • **Cambridge IBS Study**	

References: Antibiotic Therapy & Probiotics (Clinical Trials)

The Cambridge Study
Plummer S et al 2013. Effects of probiotics on the caecal and faecal microbiota of Irritable Bowel Syndrome patients receiving antibiotics: a pilot study. Short Communication. ENGIHR, Valencia Spain 18-20 September 2013, p183-6.

The Cambridge Probiotic/Antibiotic Trail
Madden JAJ, Plummer S, et al 2005. Effects of probiotics on preventing disruption of the intestinal microflora following antibiotic therapy: A double-blind, placebo-controlled pilot study. International Immunopharmacology, 5(6): 1091-1097.

The Cambridge Probiotic/Antibiotic Trial 2
Plummer S et al 2005. Effects of probiotics on the composition of the intestinal microbiota following antibiotic therapy. International Journal of Antimicrobial Agents, 26(1): 69-74.

Antibiotics and Gut Microbiome Study
A double-blind, randomized, placebo-controlled study assessing the impact of probiotic supplementation on antibiotic induced changes in the gut microbiome. Frontiers in Microbiomes 2024 March 21;3.

Some of the most studied probiotic strains in the world.