



Antimicrobial resistance: Risks and practical mitigation tools

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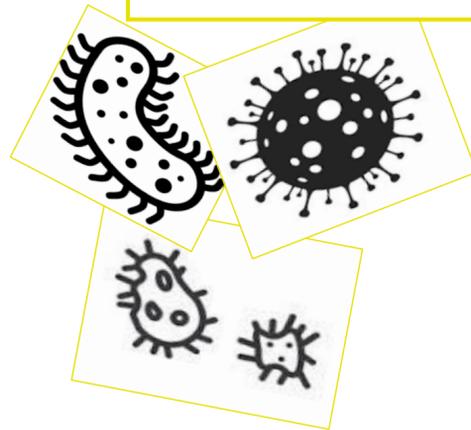
"Any chemical substance produced by microorganisms capable of inhibiting the growth or destroying bacteria and other microorganisms."

(Waksman, 1943)

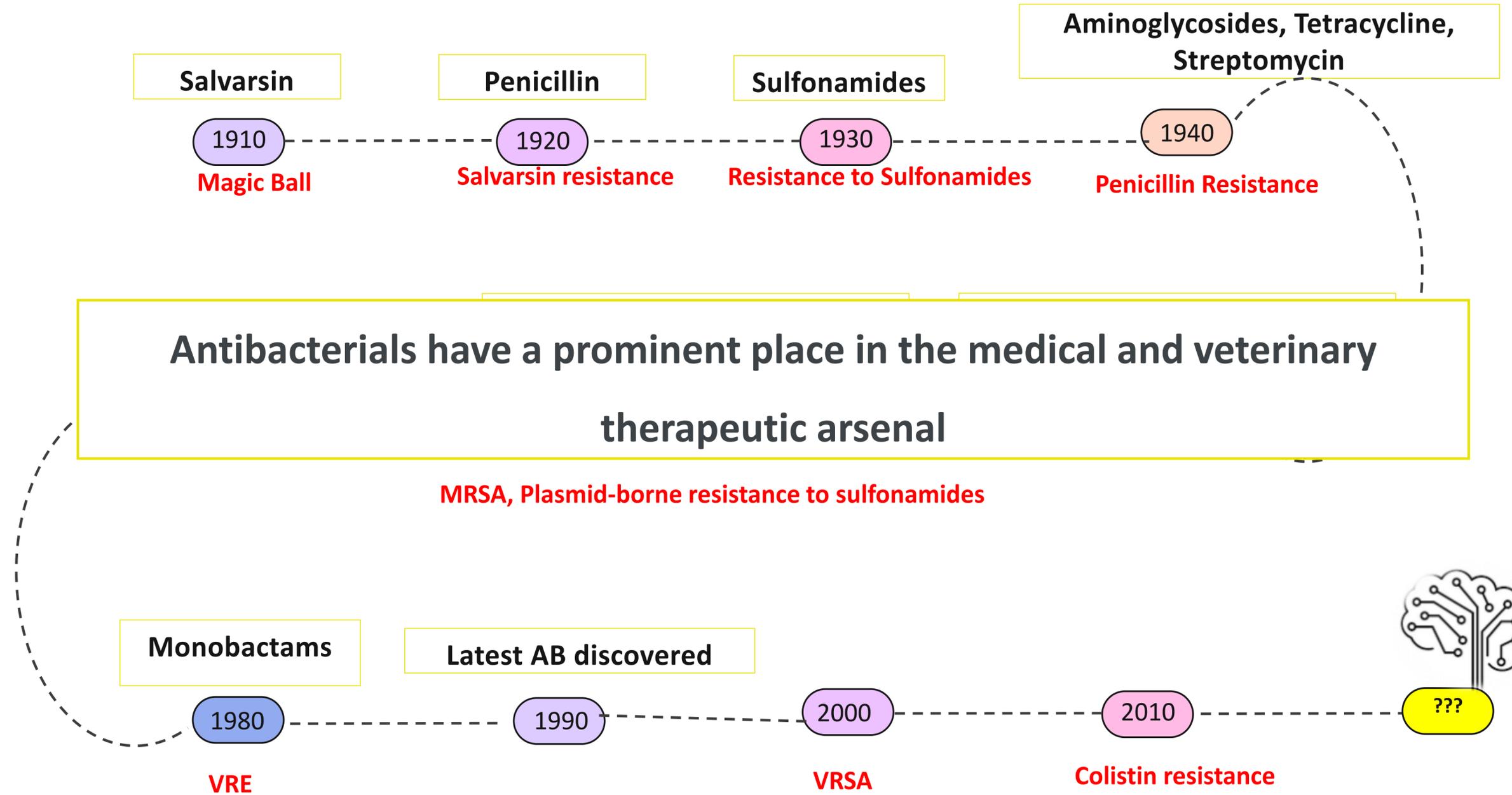
"Any chemical compound, produced by a **living organism or by synthesis**, with a high **chemotherapeutic coefficient**, whose therapeutic activity is manifested at very low doses in a specific manner, by the inhibition of certain vital processes, with regard to viruses, microorganisms or even certain multicellular beings"

(Turpin and Velu 1957)

Antimicrobials – such as antibiotics, antivirals, antifungals, and antiparasitics – are medicines used to prevent and treat infections in humans, animals, or plants.



Antimicrobial



Abstract

The discovery of antibiotics more than 70 years ago initiated a period of drug innovation and implementation in human and animal health and agriculture. These discoveries were tempered in all cases by the emergence of resistant microbes^{1,2}. This history has been interpreted to mean that antibiotic resistance in pathogenic bacteria is a modern phenomenon; this view is reinforced by the fact that collections of microbes that predate the antibiotic era are highly susceptible to antibiotics³. Here we report targeted metagenomic analyses of rigorously authenticated ancient DNA from 30,000-year-old Beringian permafrost sediments and the identification of a highly diverse collection of genes encoding resistance to β -lactam, tetracycline and glycopeptide antibiotics. Structure and function studies on the complete vancomycin resistance element VanA confirmed its similarity to modern variants. These results show conclusively that antibiotic resistance is a natural phenomenon that predates the modern selective pressure of clinical antibiotic use.

**Antibiotic resistance is an ancient phenomenon,
but also a modern-day scourge!**

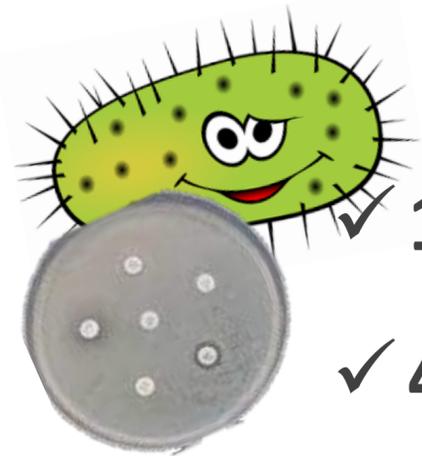


Antibiotic resistance is a global problem causing serious treatment failures leading to serious public health and economic problems

Antimicrobial resistance (AMR) occurs when bacteria, viruses, fungi, and parasites evolve over time and no longer respond to drugs, making it harder to treat infections and increasing the risk of disease spread, severe illness, and death.



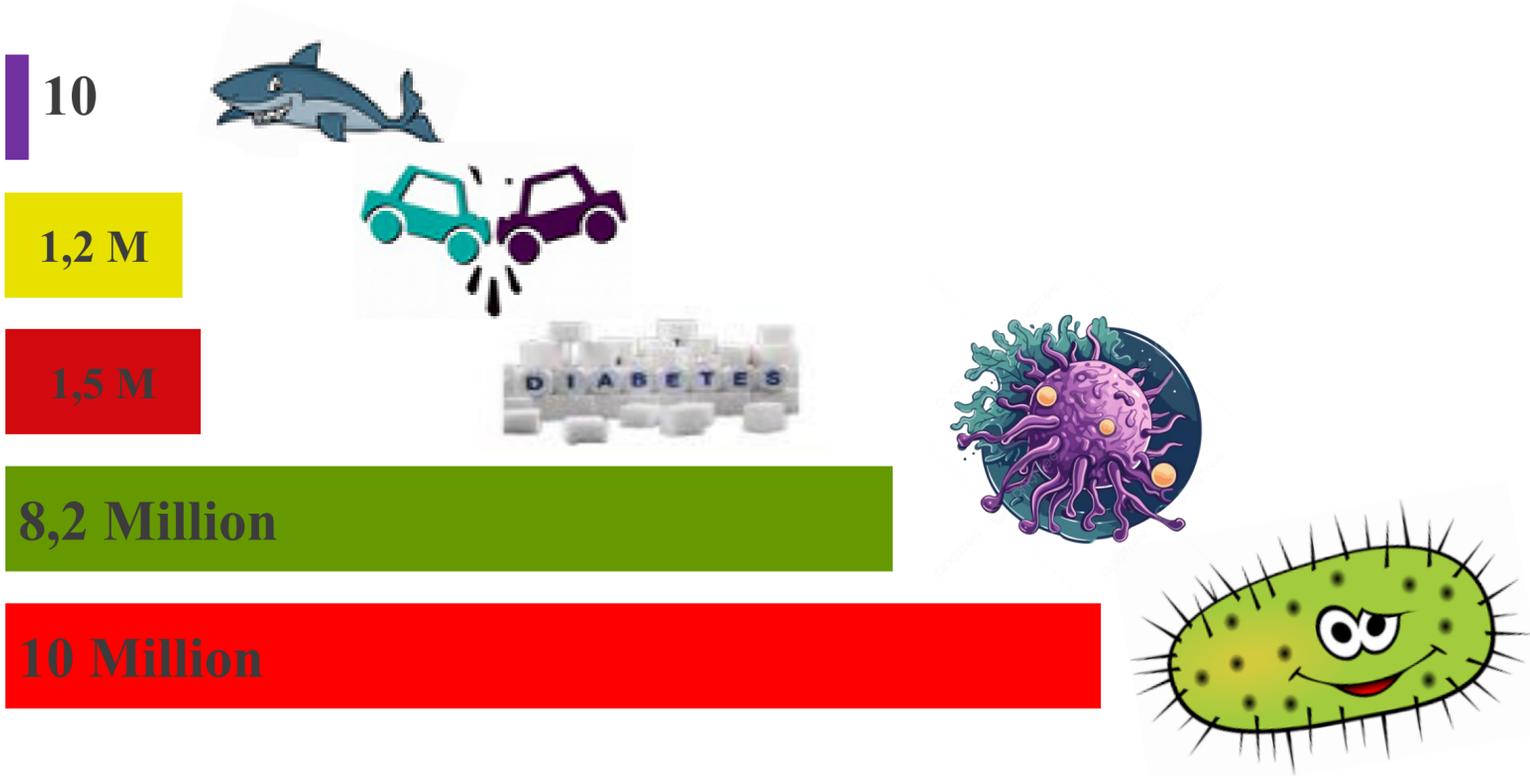
Antimicrobial Resistance (AMR) is a global public health problem



- ✓ **1.27 million** deaths directly attributable to AMR in 2019 (Lancet, 2022).
- ✓ **4.95 million** deaths associated with AMR in 2019.
- ✓ **\$100 trillion** estimated cost to the global economy by 2050 if no action is taken (World Bank).

Antimicrobial resistance

Number of deaths by 2050



Annual deaths attributable to antimicrobial resistance, compared to other causes of death
—WHO Source: The review on antimicrobial resistance

We often focus on the drug itself, but the real drivers are management and economic pressures.



Misuse & Overuse

Biosecurity &
Management Gaps



Economic Pressure

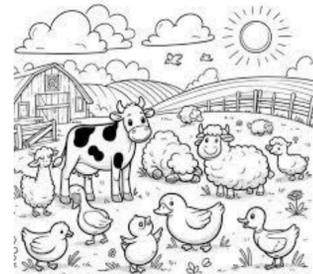
Prophylactic &
Metaphylactic Use



The objective of the study was to assess the prevalence and risk factors for ESBL/AmpC *E. coli* colonization among chicken farmers, their families, and employees in the Netherlands.

Huijbers et al., Netherlands, 2014

The study assessed 121 individuals working or living near 47 chicken farms.



96,4% in the farms

The prevalence of *E. coli* ESBL/AmpC was:



37,5% Employees



25,5% Farmers



15,7% Family members



11,4% Partners

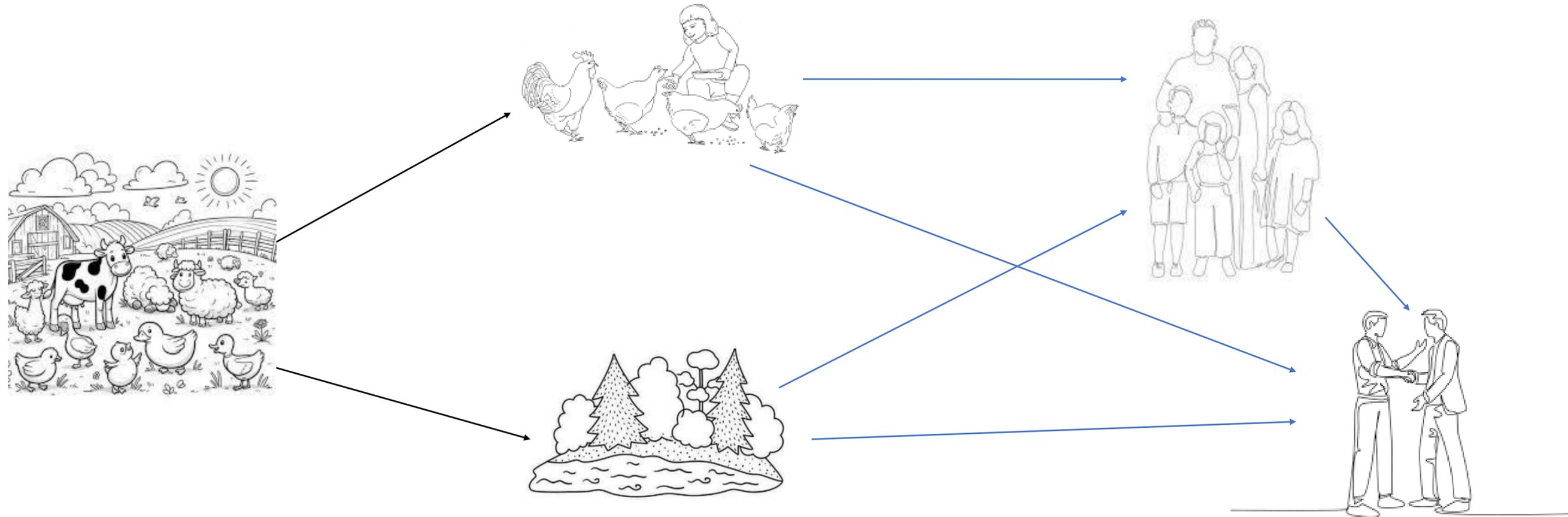
Analysis of the questionnaires showed that farmers and employees had a significantly higher duration of contact with animals than partners and other family members, as well as a higher risk of colonization with *E. coli* ESBL/AmpC.

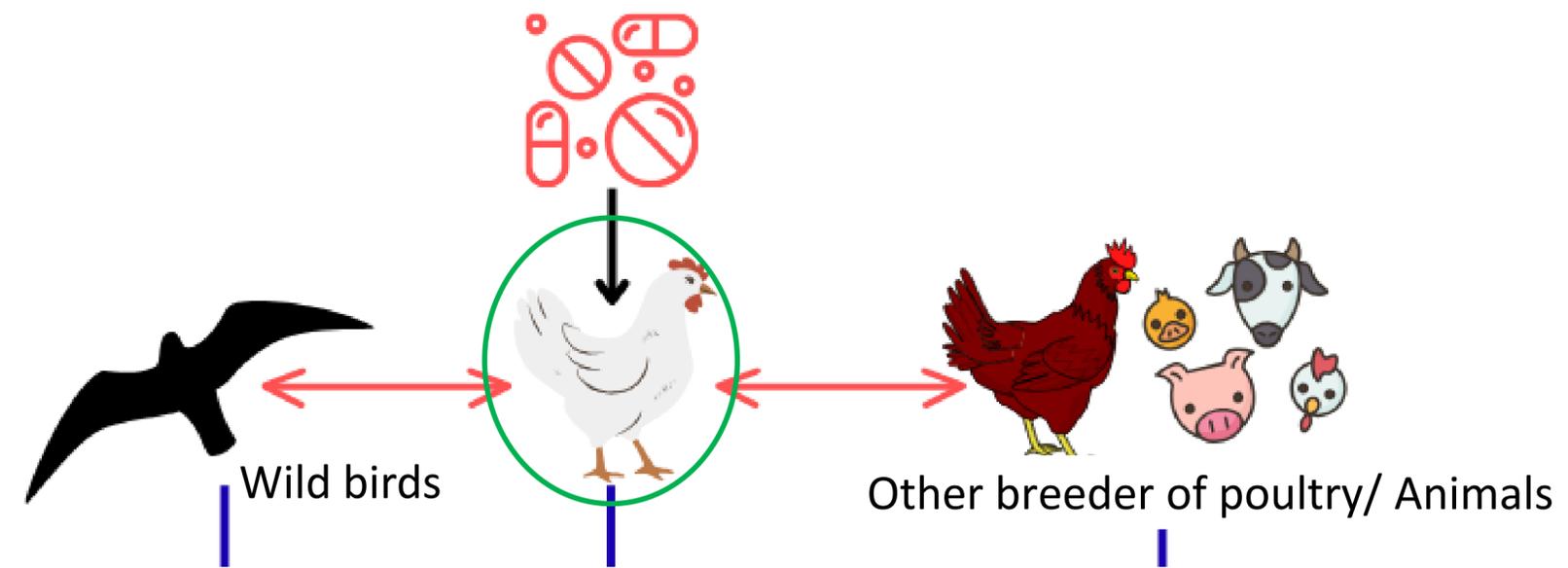
A total of 43 human isolates could be compared with 90 animal isolates: blaCMY-2, blaCTX-M-1 and blaSHV-12 genes predominated, as well as IncI1-type plasmids.

- ✓ In 5 individuals (5/43, or 11.6%), the STs, pMLST profiles, and the resistance gene matched, suggesting transfer from the isolate itself.
- ✓ In two additional cases, the resistance genes were carried by plasmids from the same family, suggesting horizontal transfer between *E. coli* isolates between chickens and humans (in total, 7/43, or 16.3%).
- ✓ In one case, an *E. coli* ST117/CMY-2 isolate was shared between the farmer and a family member.

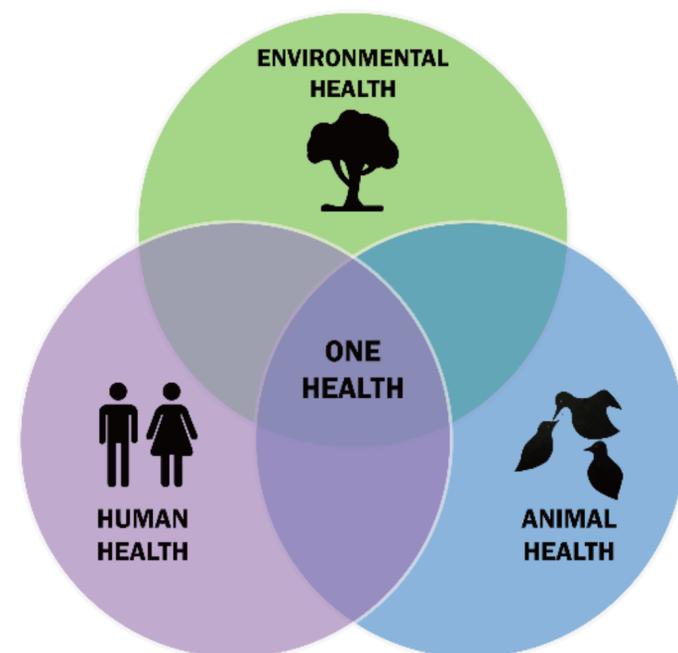
Antimicrobial resistance

The authors concluded that farmers and people working or living near chicken farms were at greater risk of colonization through direct contact or indirect transmission via the environment. This is especially true since the epidemiology of ESBL/AmpC found in these individuals was very similar to that of animals, but different from that of the general population in the Netherlands (where the CTX-M-15 enzyme predominates).





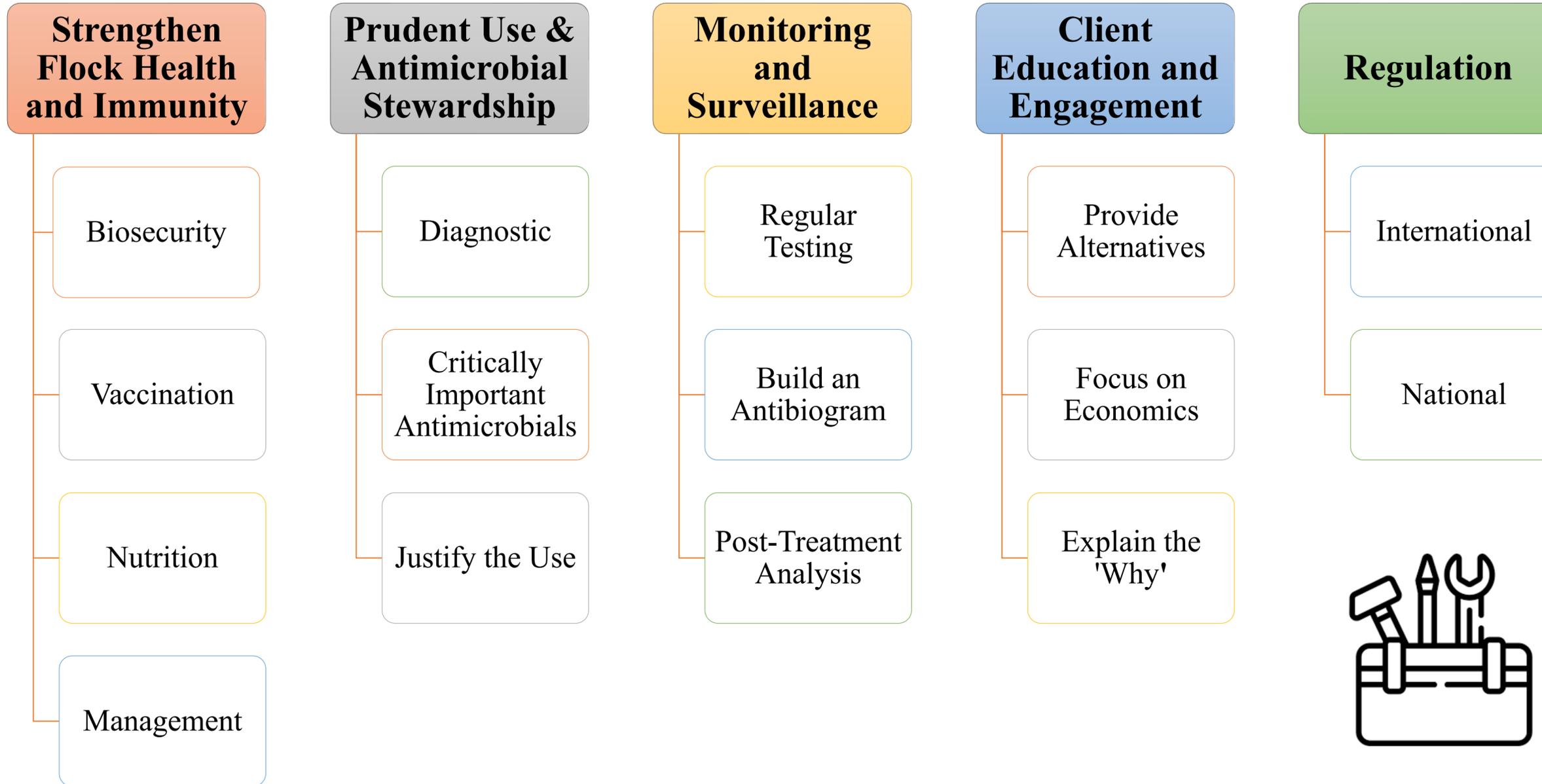
Mitigation tools



AMR is a multi-sectoral problem driven by misuse across human health, animal health, and the environment



Mitigation tools

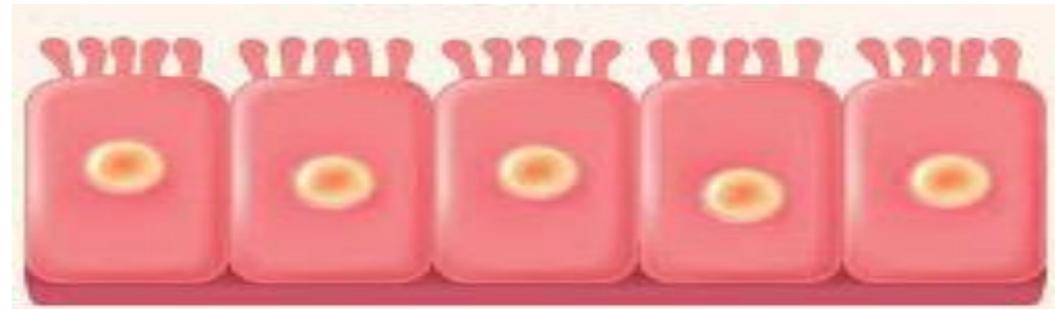


Mitigation tools

Livestock Performance, Production Intensification
Resistance, Residues



*Resilience, Sustainable Production,
One Health, Environment*



Alternatives to AM

=

**Control of
pathogen
proliferation**

+

**Action on the
microbiota**

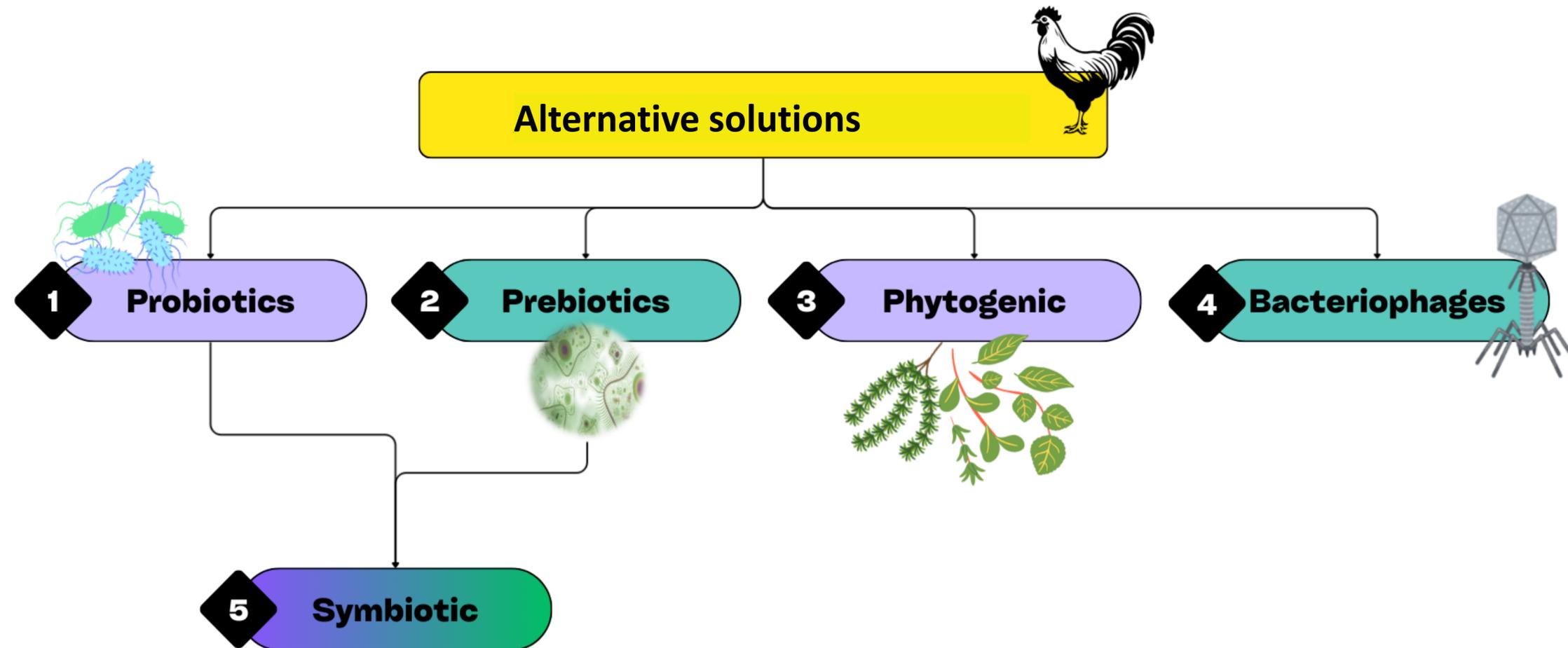
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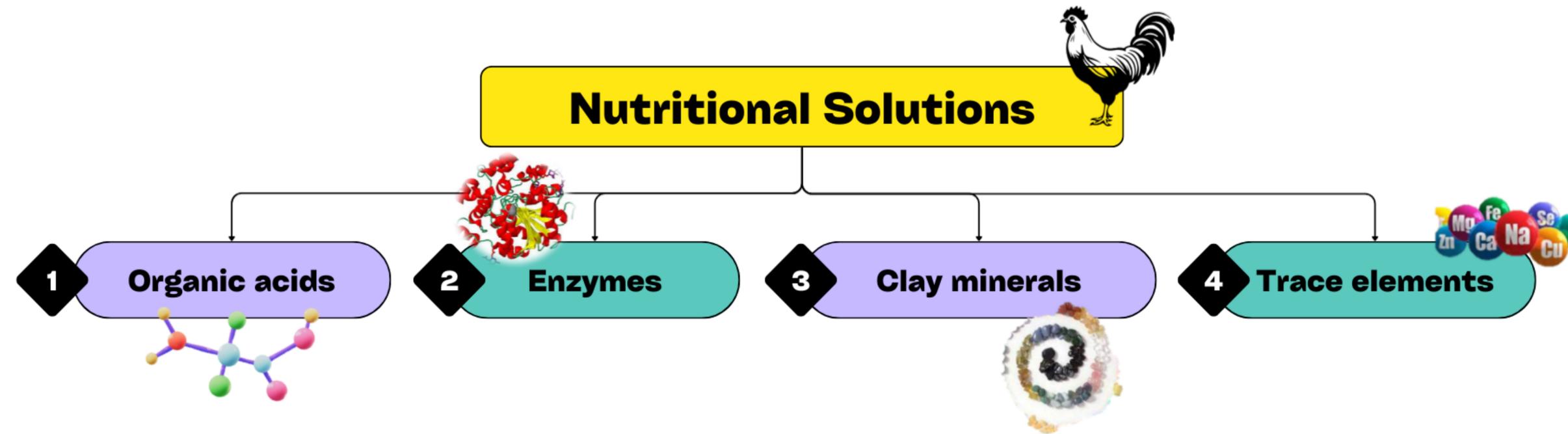
**Anti-inflammatory
action**

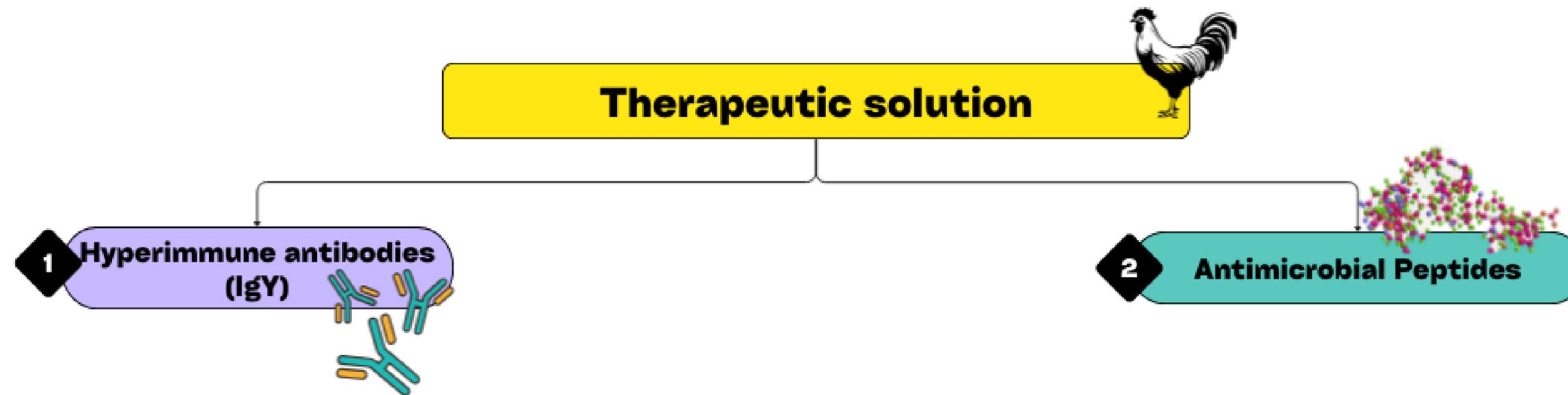
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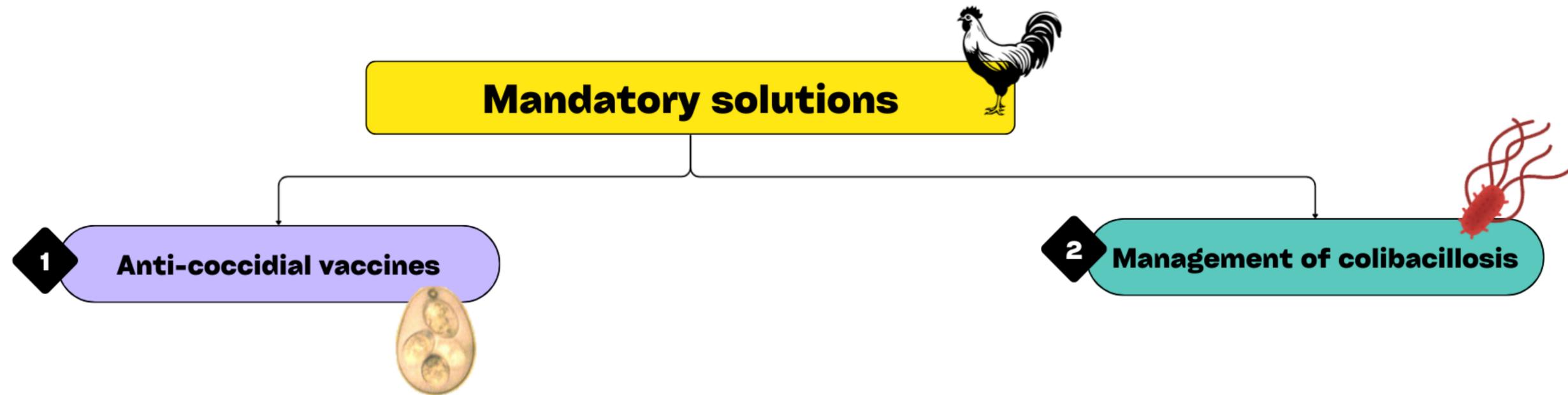
**Improved
absorption rate**

+ Resilience, Sustainable, One Health

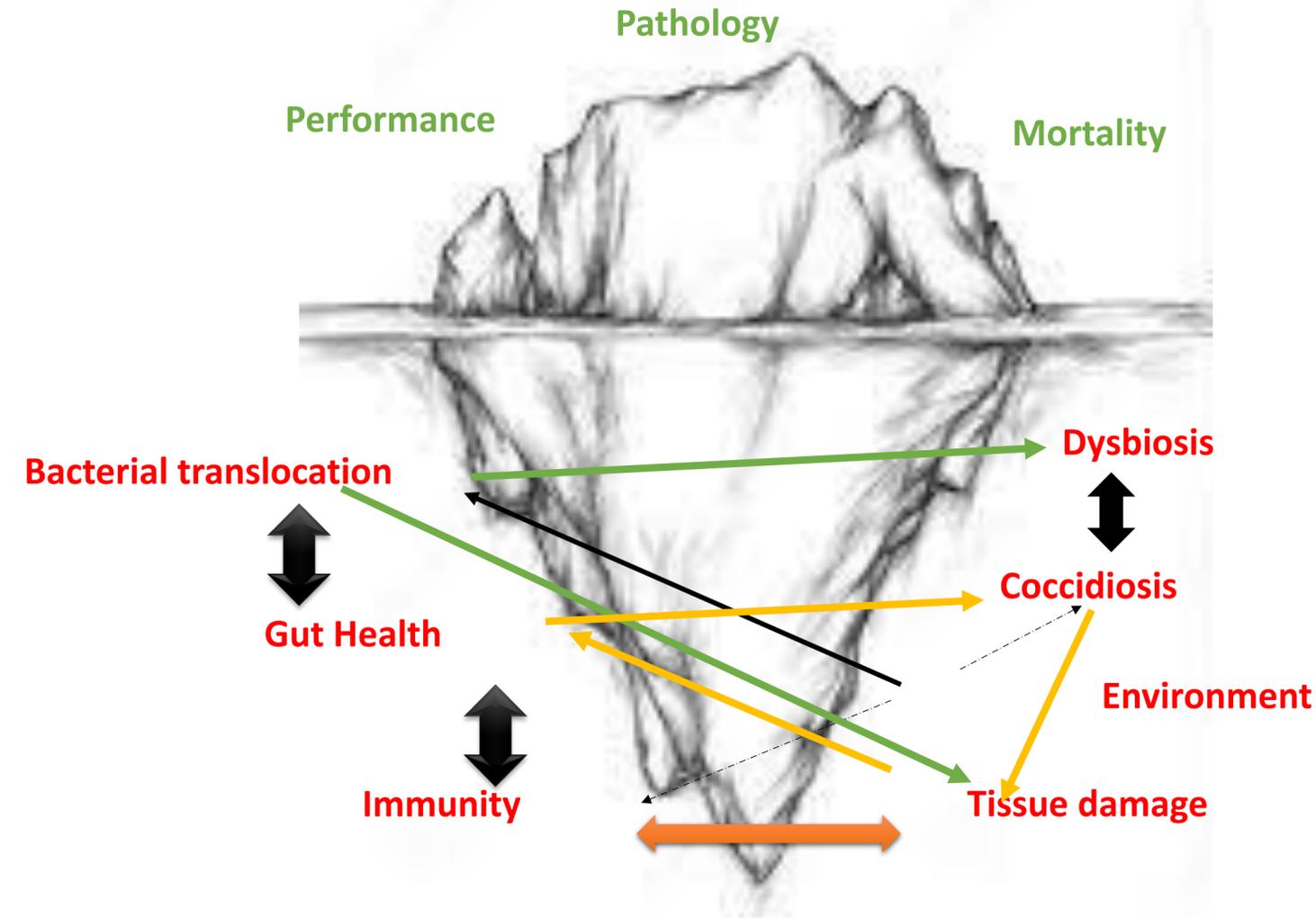








Which solution should be adopted?



Which solution should be adopted?

Nutritional strategy: Adapted to our context

Holistic Veterinary Medicine

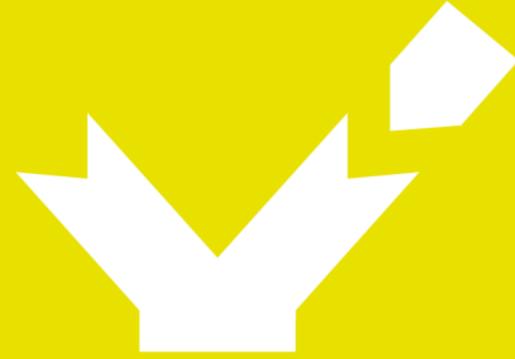
Regulations

Collaboration between nutritionists and veterinarians

Development of intestinal health monitoring tools

Give these solutions time to express themselves!





Thank You!