Animal feeds and the need to decrease the use of antimicrobials in animals

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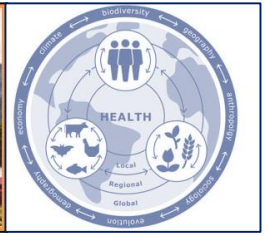
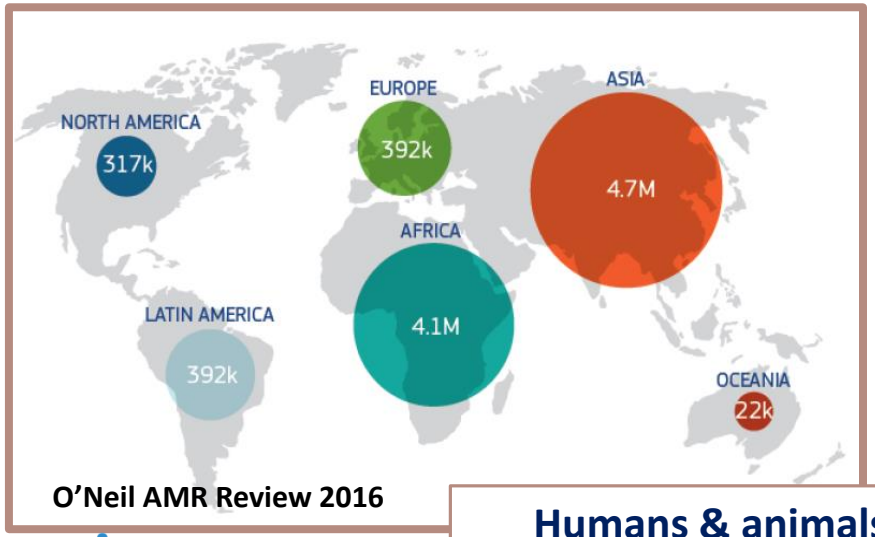
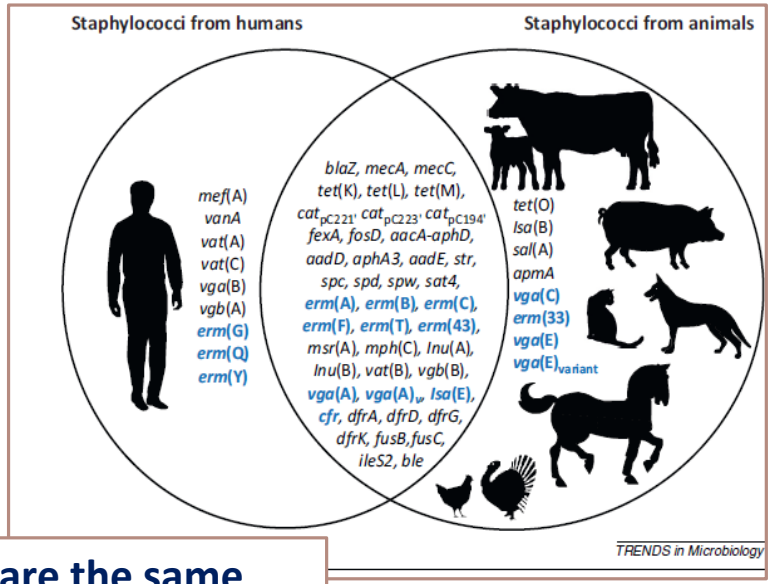


Antimicrobial resistance: a global concern

Projection of the number of deaths attributable to AMR by 2050



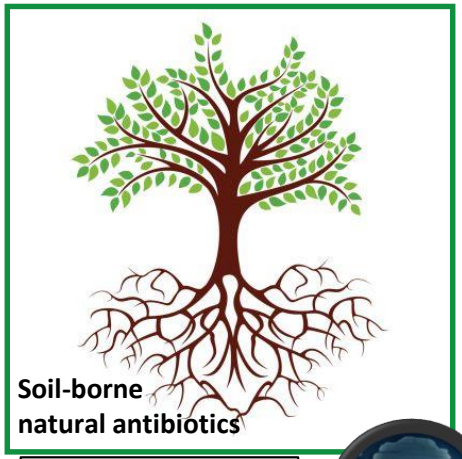
O'Neil AMR Review 2016



Humans & animals share the same bacteria and often also the same resistance genes

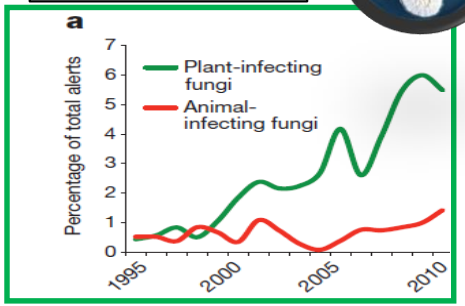
Source Wendlandt et al., 2015

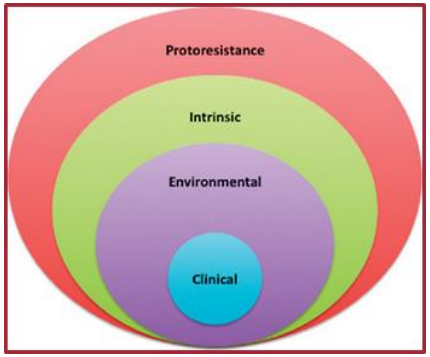
AMR – mirroring a changing world?

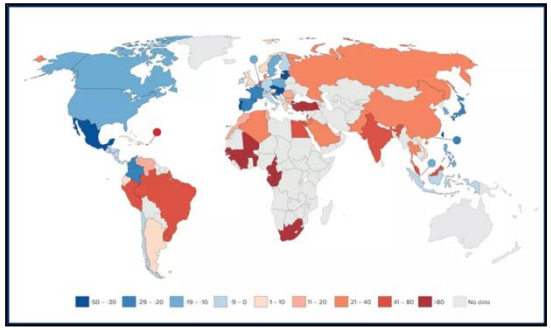


Soil-borne
natural antibiotics

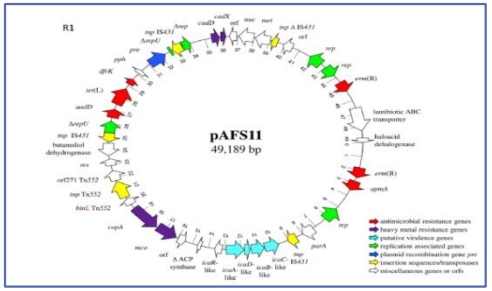
Bacteria:
adaptive AMR







Global consumption
of AB: driver of AMR

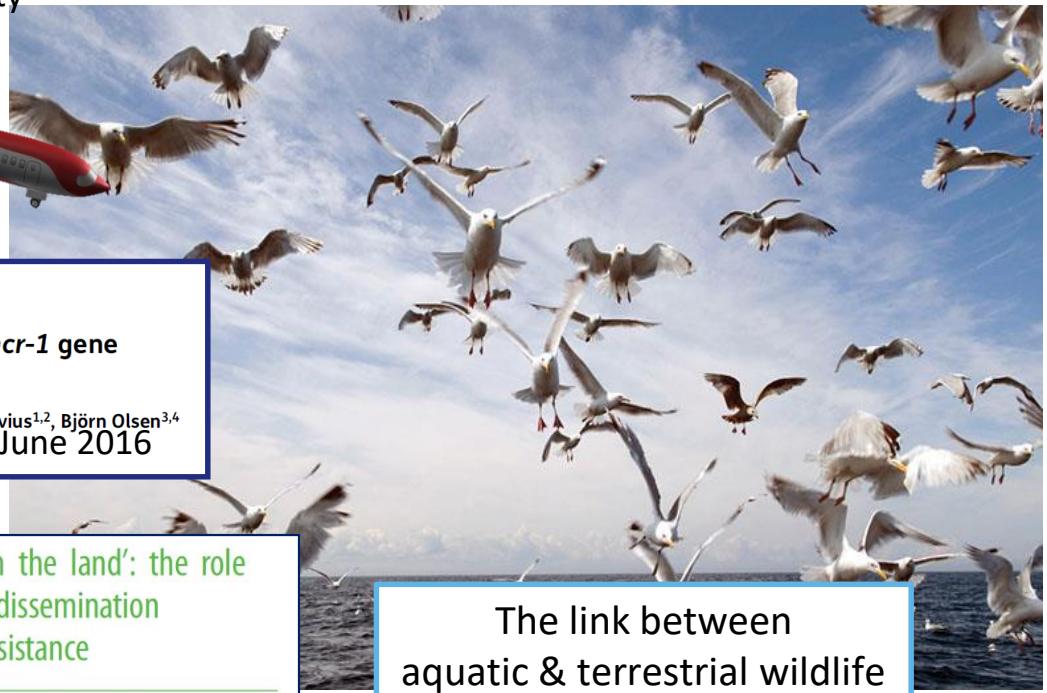


ENVIRONMETAL POLLUTION:
Biocides and heavy metal resistance genes enforce and facilitate re-assemblage of plasmids and stimulate biofilm formation

AMR across boarders: the need for global action plans

Mcr-1 (Colistin) as an example

Global mobility
& transport



J Antimicrob Chemother
doi:10.1093/jac/dkw262

The colistin resistance *mcr-1* gene is going wild

Apostolos Liakopoulos[1]*, Dik J. Mevius[1,2], Björn Olsen[3,4] and Jonas Bonnedahl[5]

June 2016

'Disperse abroad in the land': the role of wildlife in the dissemination of antimicrobial resistance

Kathryn E. Arnold[1], Nicola J. Williams[2] and Malcolm Bennett[3]

The link between
aquatic & terrestrial wildlife

Colistin= CIA

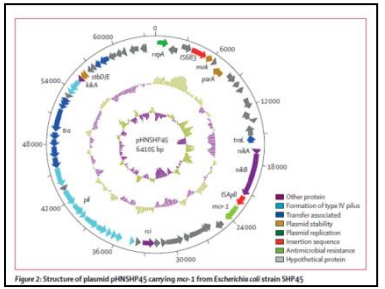


Figure 2: Structure of plasmid pHNSHP45 carrying *mcr-1* from *Escherichia coli* strain SHP45

AMR: The mandate for the livestock industry

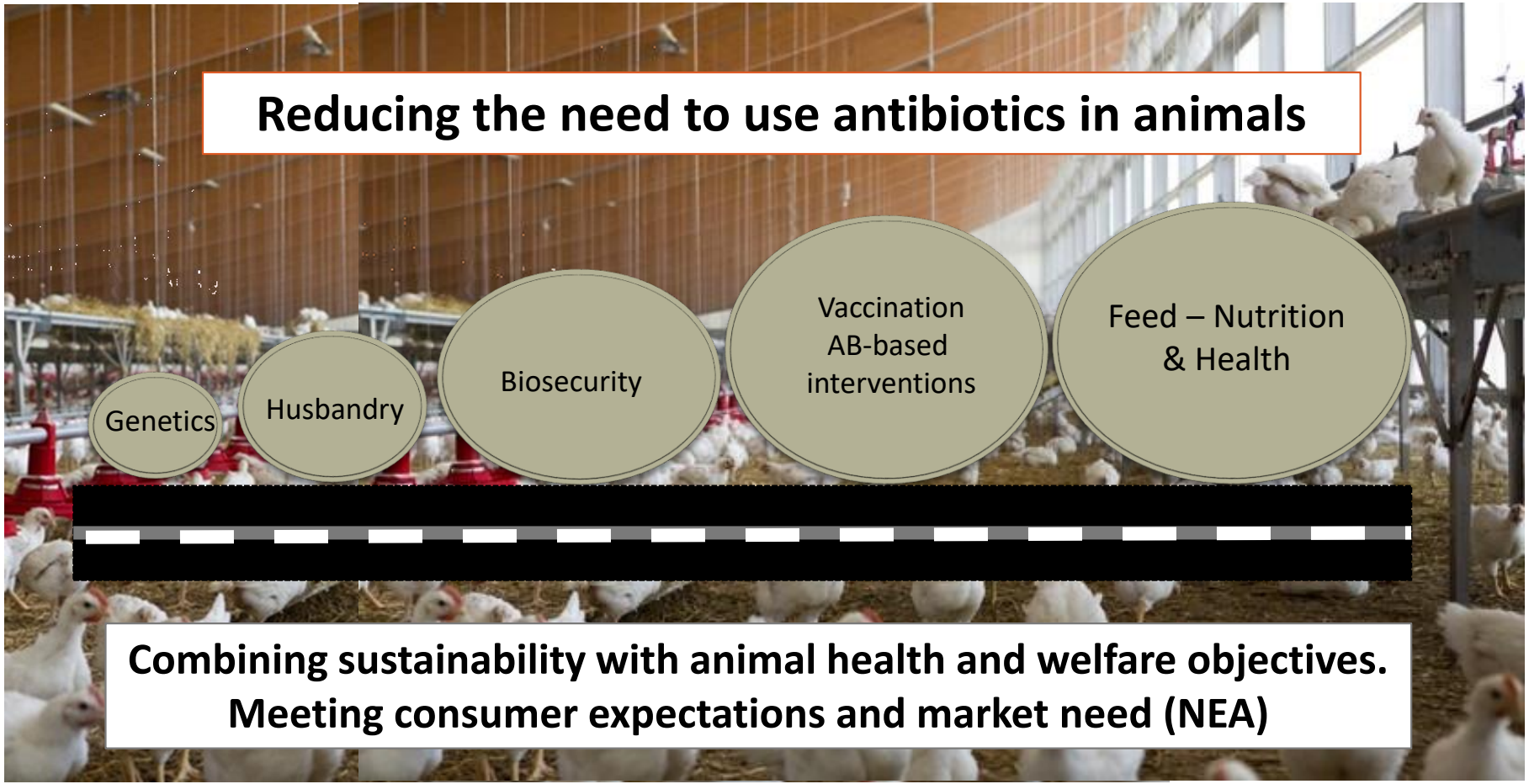
Creating awareness
Monitoring antibiotic use and AMR

Stimulating prudent us of antimicrobials in animals:
Banning the use of antimicrobials
as growth-promoting agents

Implementing Antibiotic Stewardship principles
Improving rapid diagnostics, improve the efficacy of antibiotics
in the treatment of bacterial infections

Reducing the need to use antibiotics in animals

Reducing the need to use antibiotics in animals



Combining sustainability with animal health and welfare objectives.
Meeting consumer expectations and market need (NEA)

Rethinking Feed - Nutrition - Health

- Designing tailor-made diets for all species & categories (nutritional needs)
- Improving the animal's **resilience** to infectious diseases
- Improving animal **health and maintaining performance**
- Supporting sustainable animal husbandry & **animal welfare**
- Supporting **environmental compliance** of (intensive) animal farming

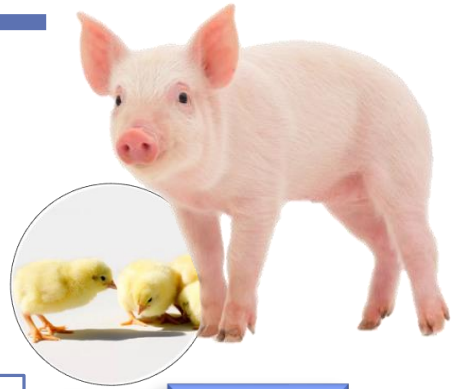
1. Keeping animals healthy – reflections on natural defense mechanisms!

Innate/Natural Immunity:
non-specific

1st line of defense

Anatomic barriers (skin)
Mucosal barriers (and secretions)
Physiological microbiome

"Border control" against invading pathogens



2nd line

Innate immune cells (MØ)
& clinical signs of inflammation
Acute Phase Response (APR)

Adaptive/acquired Immunity:
disease (antigen) specific

3rd line of defense

B-cells (antibody production)
(infection / vaccination)
T-cells (Th1/Th2, Th17, NK)

Humoral & cellular immunity

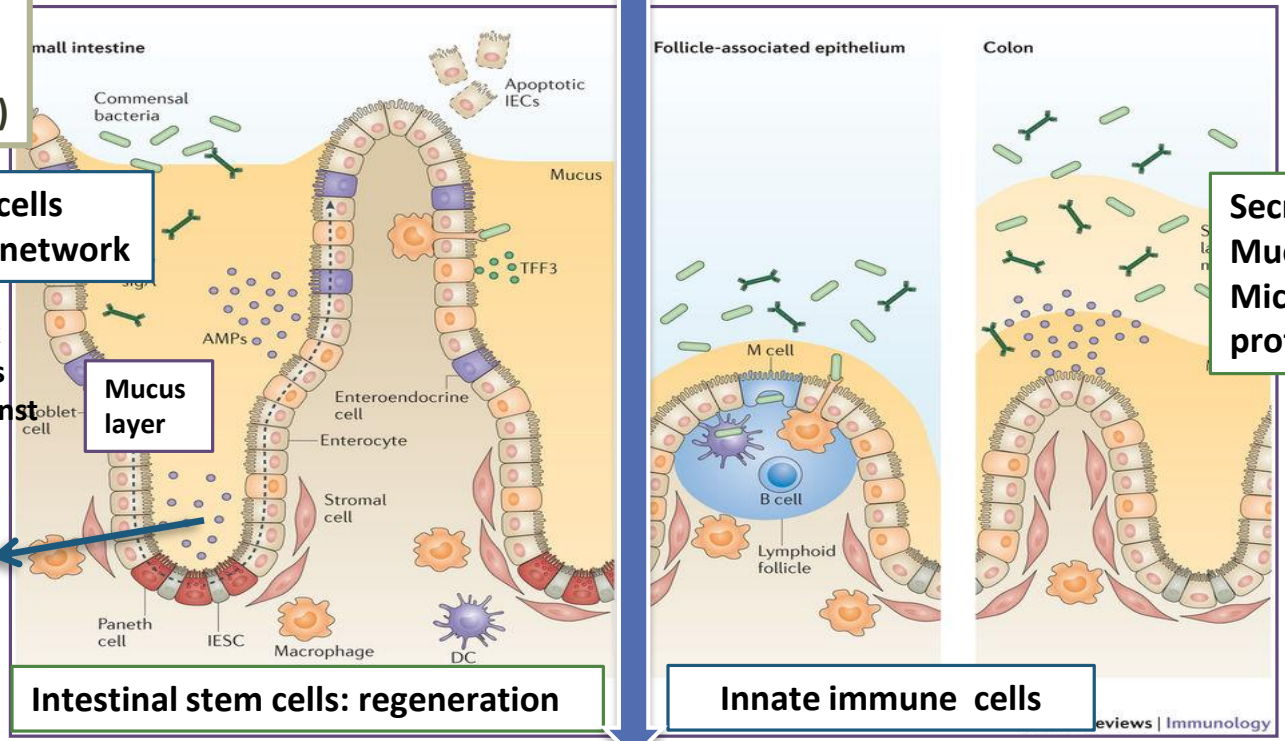
The 1st line of defense: focus on gut health

Physiological Microbiome (Commensals)

Epithelial lining cells & tight junction network

GST & Efflux Transporters (1st line against chemicals)

Defensins: AMPs



Secretory IgA Mucus & Microbiome protection

Intestinal stem cells: regeneration

Innate immune cells

The intestinal tissue harbours 60-70% of the immune system

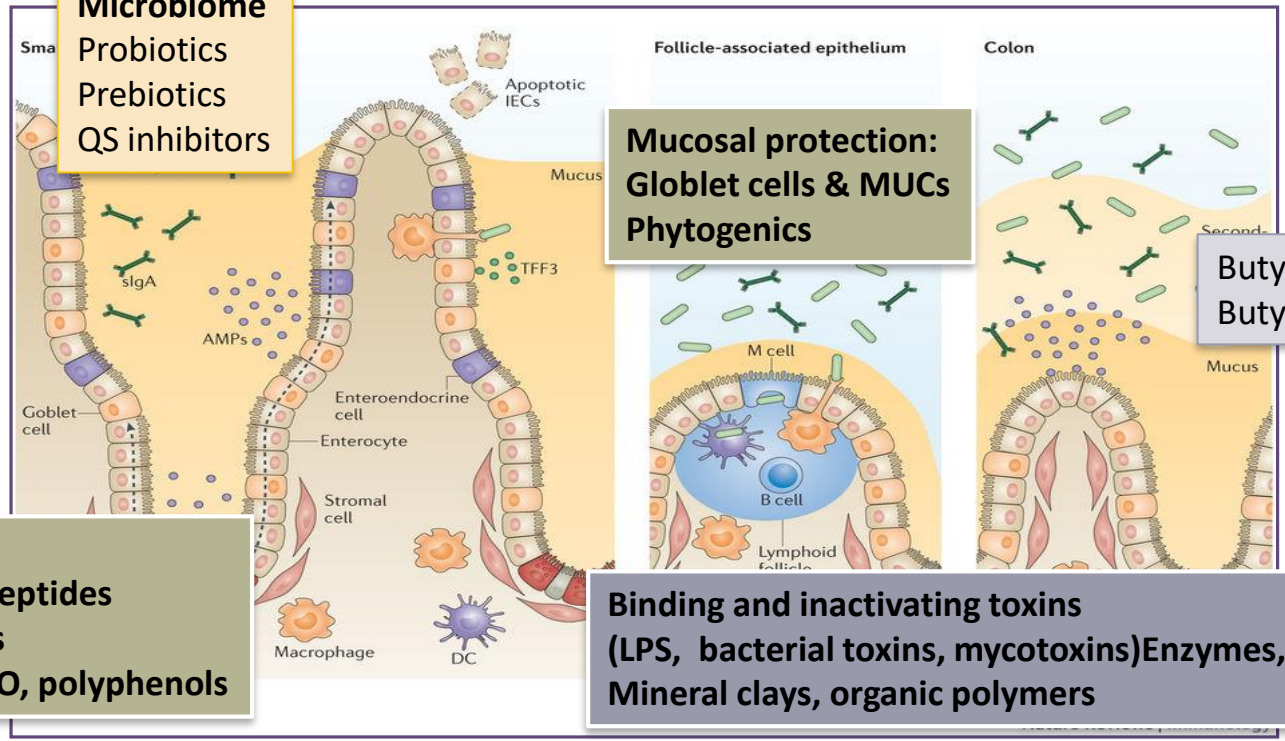
Figure: Reviews in Immunology, 14, 142-153, 2014

Supporting the 1st line of defense: targets for intervention

Microbiome
Probiotics
Prebiotics
QS inhibitors

Pre-systemic support:
Acidifiers
SCFA/MCFA

Tijgt junction Integrity0:
AS, FA, OS



Mucosal protection:
Globlet cells & MUCs
Phytogenics

Butyrins &
Butyrates

GI secretions
Antimicrobial peptides
Oxidative stress
Phytogenics / EO, polyphenols

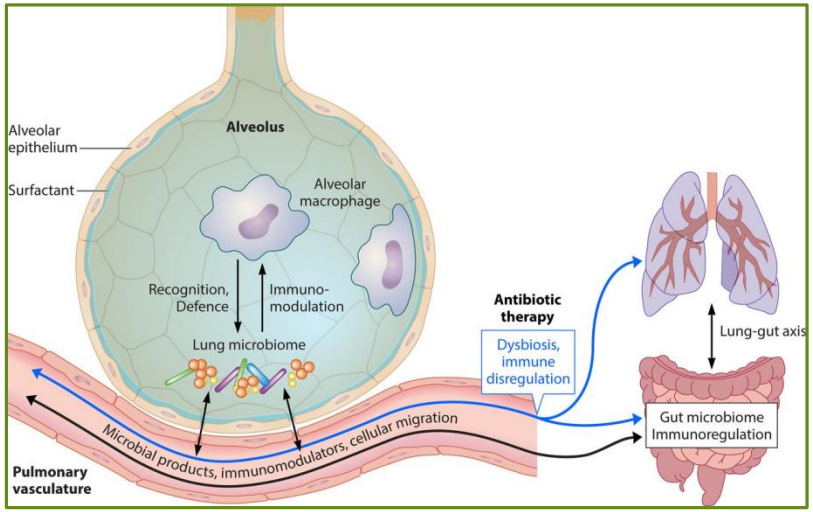
Binding and inactivating toxins
(LPS, bacterial toxins, mycotoxins)Enzymes,
Mineral clays, organic polymers

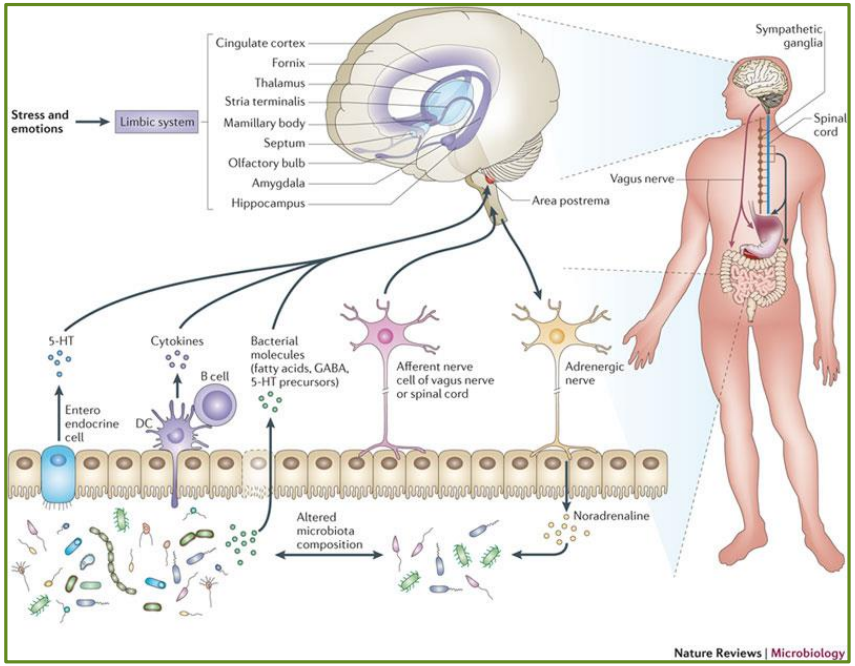
MoA: Direct and indirect interactions with the immune system via Cytokines, GPR, signalling

Figure: Reviews in Immunology, 14, 142-153, 2014

Gut health – more than a healthy gut!

Appreciation of physiology & behaviour

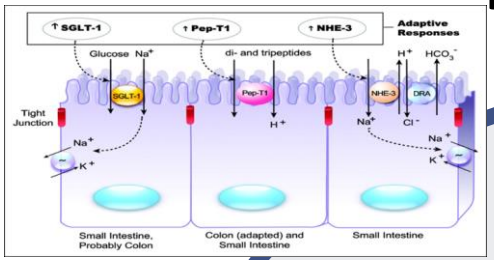




Gut health supports lung health!

Gut – brain axis

Linking the *mode to action* to daily problems: Identifying stressors in daily life



Nutrient Transport/ Utilization

Birth hypoxia

Social stress

Environmental stress

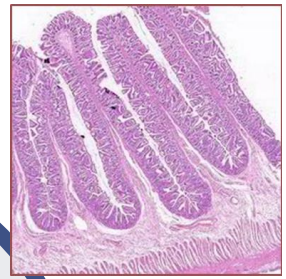
Colostrum supply
Microbiome development

Transport stress

Weaning & Regrouping

Undesirables substances in feed (mycotoxins, LPS

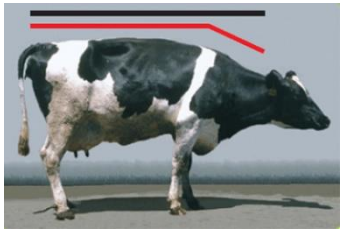
Feed changes
Water supplies



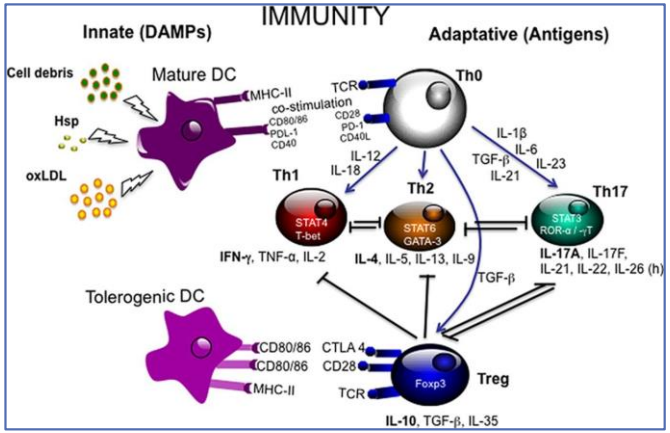
GIT integrity and function

Increasing the resilience to infectious diseases

Gut health and the Inflammasome: Impact on Animal Welfare



Identifying animal-based indicators



Identifying and monitoring of markers of stress, inflammation & tissue regeneration

Insights and opportunities

The application of antibiotics (particularly in early life) often suppresses the essential biodiversity of the intestinal microbiome - thereby creating an antibiotic-dependency
→ Phasing out of AGPs

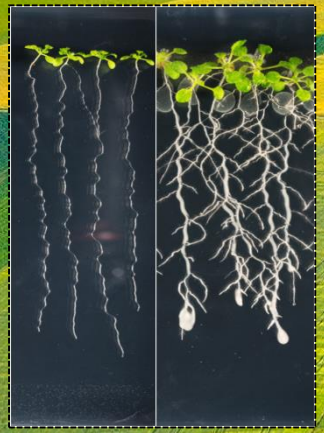
The use of health-promoting feed additives requires an understanding of their mechanisms of action (from descriptive morphology of intestinal tissues to
→ MoA –driven product/combinations (synbiotics)

The use of health-promoting feed additives demands advanced technologies
→ coatings, targeted formulations

Compliance with all feed safety standards need to be demonstrated

Sustainable production techniques should be encouraged

Closing the food gap: healthy planet diets



Soil management

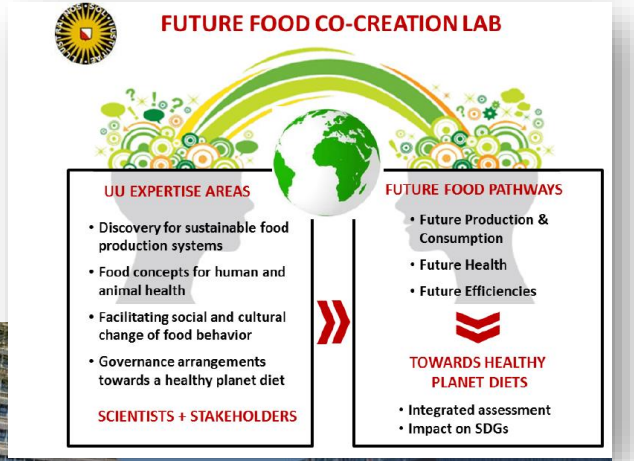
Prevention of Deforestation

Waste recycling creating new protein sources (insect feed)

Health Management

Precision agriculture:
Increasing efficiency – recycling & saving natural resources

Thank you



Future Food Utrecht:
www.uu.nl/en/research/future-food-utrecht

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