Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

# Relevance of mastitis control to contain AMR

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Food Safety Officer
Food and Agriculture Organization of the United Nations (FAO)

**Experiences with Use of Herbs for Mastitis Control**
International Dairy Federation (IDF) webinar
Tuesday, December 6, 2022

Working for #ZeroHunger

- DVM (ICBAS, UP, 2001)
- **2002- 2007: Dairy cattle practitioner**
- MS Food Science and Technology (ESB-UCP, 2007)
- PhD Population Medicine and Public Health
  Graduate certificate: Public Policy (NCSU, USA, 2011)
- Public Health and Food Safety consultant
  SAFOSO (Bern, Switzerland)
- Residency - Diplomate European College of Veterinary Public Health
- Deputy Head AMR & Vet Products Dep.
  World Organisation for Animal Health, OIE (Paris, France)
- Currently: Food Safety Officer
  Food and Agriculture Organization (FAO) of the United Nations (Rome, Italy)

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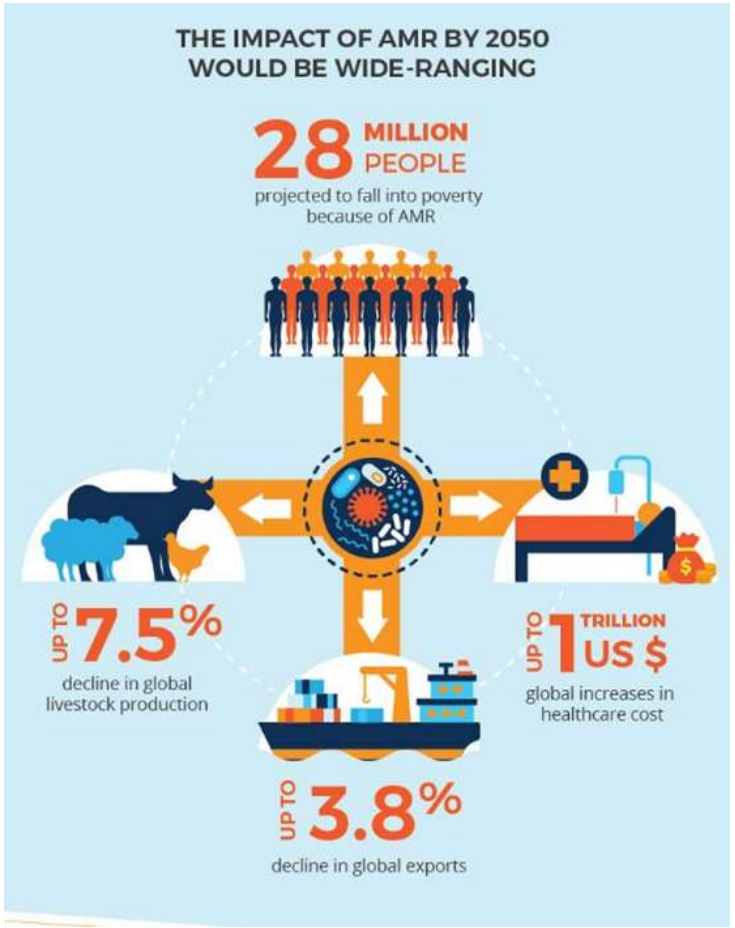
Articles

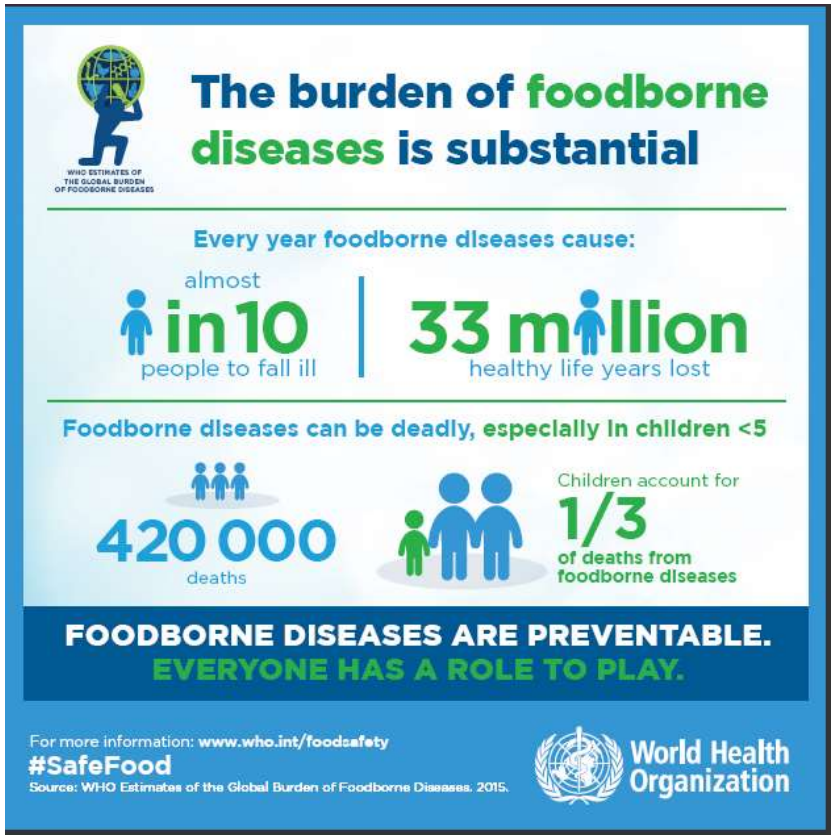
Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis




Articles

The burden of bacterial antimicrobial resistance in the WHO European region in 2019: a cross-country systematic analysis

# FBD and the Sustainable Development Goals

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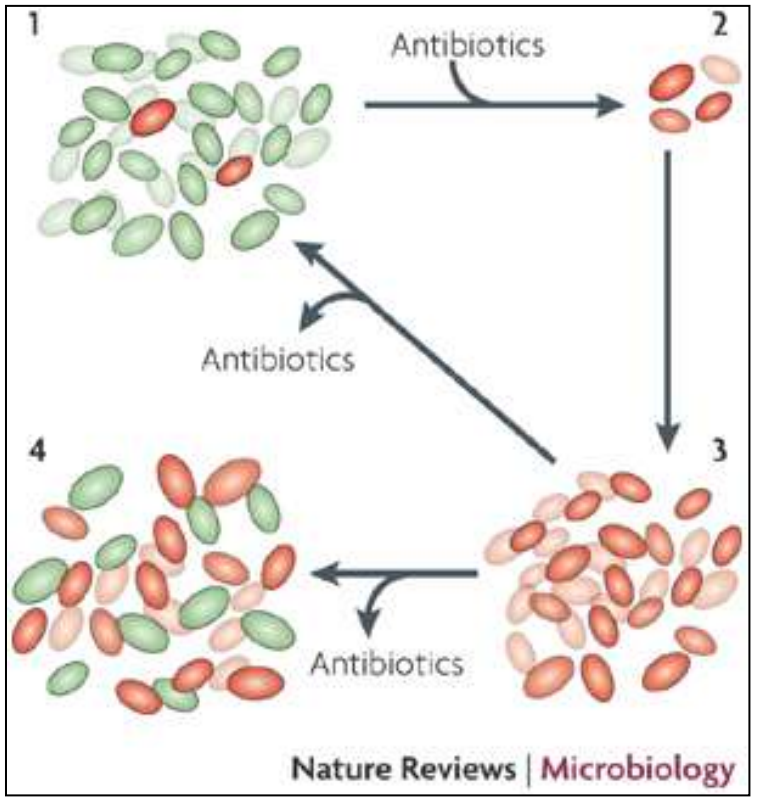
# Two different worlds?

## FOOD

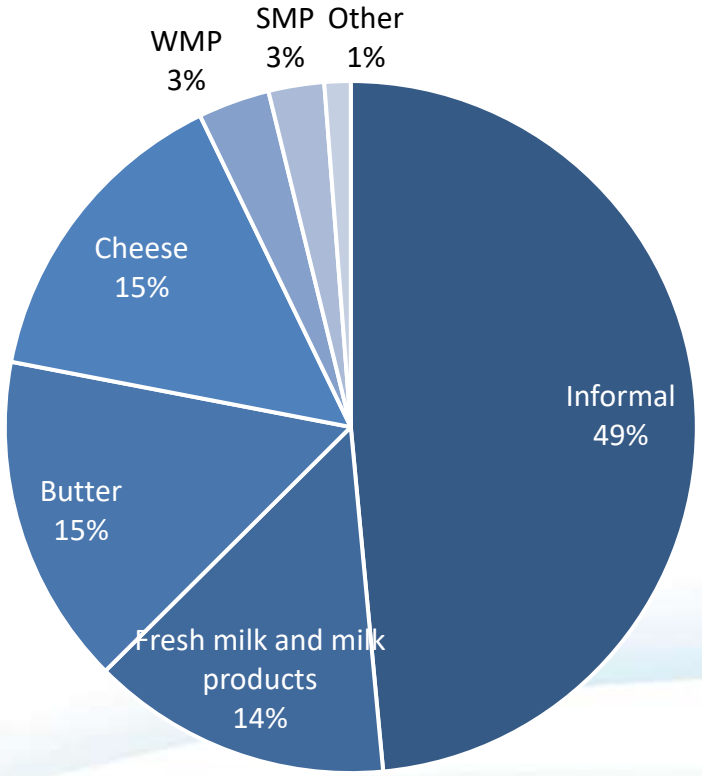
## AMR



# Dairy Consumption

7.9 billion

118.2 kg/capita/year




N.B.: conversion in milk equivalent is based on the non-fat solid content methodology for stock variation and the fat and protein content methodology for the calculated apparent consumption

frontiers | Frontiers in Microbiology

ORIGINAL RESEARCH

# Meta-Analysis for the Global Prevalence of Foodborne Pathogens Exhibiting Antibiotic Resistance and Biofilm Formation

OPEN ACCESS

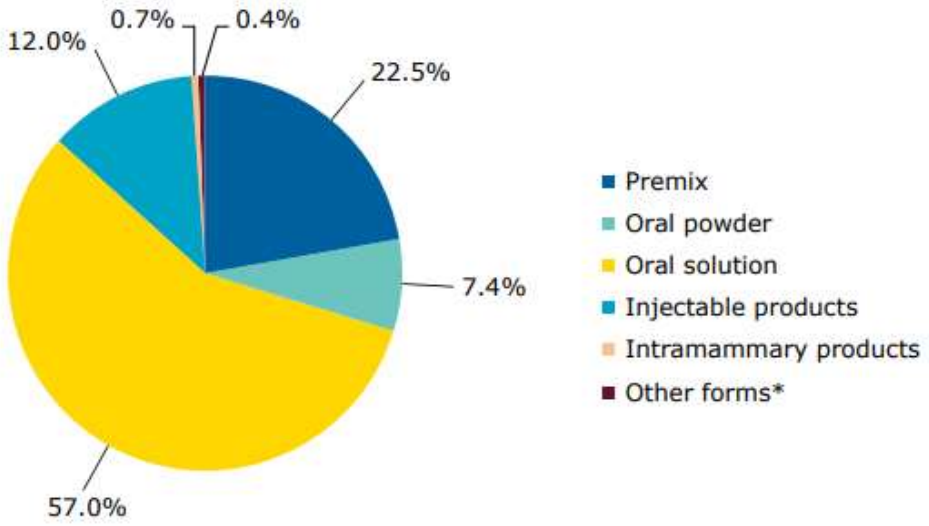
Qian Tao[†], Qian Wu[†], Zhaohuan Zhang[*†], Jing Liu[†], Cuifang Tian[†], Zhenhua Huang[†], Pradeep K. Malakar[†], Yinglie Pan[*†] and Yong Zhao[*†]

Antimicrobial-resistant (AMR) foodborne bacteria causing bacterial infections pose a serious threat to human health. In addition, the ability of some of these bacteria to form biofilms increases the threat level as treatment options may become compromised. The extent of antibiotic resistance and biofilm formation among foodborne pathogens remain uncertain globally due to the lack of systematic reviews. We performed a meta-analysis on the global prevalence of foodborne pathogens exhibiting antibiotic resistance and biofilm formation using the methodology of a Cochrane review by accessing data from the China National Knowledge Infrastructure (CNKI), PubMed, and Web of Science databases between 2010 and 2020. A random effects model of dichotomous variables consisting of antibiotic class, sample source, and foodborne pathogens was completed using data from 332 studies in 36 countries. The results indicated AMR foodborne pathogens has become a worrisome global issue. The prevalence of AMR foodborne pathogens in food samples was greater than 10% and these foodborne pathogens were most resistant to β-lactamase antibiotics with *Bacillus cereus* being most resistant (94%). The prevalence of AMR foodborne pathogens in human clinical specimens was greater than 19%, and the resistance of these pathogens to the antibiotic class used in this research was high. Independently, the overall biofilm formation rate of foodborne pathogenic bacteria was 90% (95% CI, 88%–96%) and a direct linear relationship between biofilm formation ability and antibiotic resistance was not established. Future investigations should document both AMR and biofilm formation of the foodborne pathogen isolates in samples. The additional information could lead to alternative strategies to reduce the burden caused by AMR foodborne pathogens.

Keywords: foodborne pathogens, antimicrobial resistance, biofilm, meta-analysis, global prevalence

- **First comprehensive meta-analysis of global prevalence of antibiotic resistance and biofilm formation in foodborne pathogens**
- **332 studies, in 36 countries**
- **Foodborne pathogens present high levels of antibiotic resistance, both in food samples and clinical specimens**
- **Less clear a direct linear relationship exists between the ability to form biofilms and antibiotic resistance**

**Figure 8.** Distribution of sales, in mg/PCU, of the various product forms of antimicrobial VMPs for food-producing animals, aggregated by the 31 European countries, in 2020




* 'Other forms' includes oral pastes, boluses and intrauterine products.

11th ESVAC report

# Relevance of mastitis control to contain AMR from a One Health perspective

- Animal
- Human
- Plants
- Environment

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# Juhasz-Kaszanyitzky, E. (2007):

First documented case of potential direct transmission of MRSA between cows and humans

DISPATCHES

## MRSA Transmission between Cows and Humans

Éva Juhász-Kaszanyitzky,* Szilárd Jánosi,*
Pál Somogyi,* Ádám Dán,*
Linda van der Graaf-van Bloois,†‡
Engeline van Duijkeren,‡
and Jaap A. Wagenaar†‡

We isolated methicillin-resistant *Staphylococcus aureus* (MRSA) from cows with subclinical mastitis and from a person who worked with these animals. The bovine and human strains were indistinguishable by phenotyping and genotyping methods and were of a low frequency *spa* type. To our knowledge, this finding indicates the first documented case of direct transmission of MRSA between cows and humans.

agar. The isolates initially characterized as staphylococc were tested for coagulase production (in tubes) and with Slidex Staph Plus test (bioMérieux, Marcy l'Etoile France) to confirm their identification as *S. aureus*. From this farm, 375 *S. aureus* strains were isolated. The strains were tested for antimicrobial drug susceptibility, production of β-lactamases, and presence of *mec*A by PCR (*5*). The first MRSA strain was isolated in spring 2002; during the next 15 months, 26 additional MRSA strains were isolated from this dairy herd.

In December 2002, tonsil swabs were collected once from 12 workers on this farm who were in close contact with the cows (veterinarian, milkmen, and attendants) and who gave informed consent. (The study was approved by the Ethical Committee of the National Center for Epidemiology, Budapest, Hungary.) Culturing and identification of *S. aureus* were carried out by the above-described method. *S. aureus* was isolated from 3 samples. One of these isolates was resistant to methicillin by disk diffusion and E-test, and the presence of the *mec*A gene was con-

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# Avoid antibiotic resistance in calves fed waste milk

Contributed by Mike Opperman  Published on 24 February 2022

https://www.progressivedairy.com/topics/calves-heifers/avoid-antibiotic-resistance-in-calves-fed-waste-milk

SCIENTIFIC OPINION

EFSA Journal

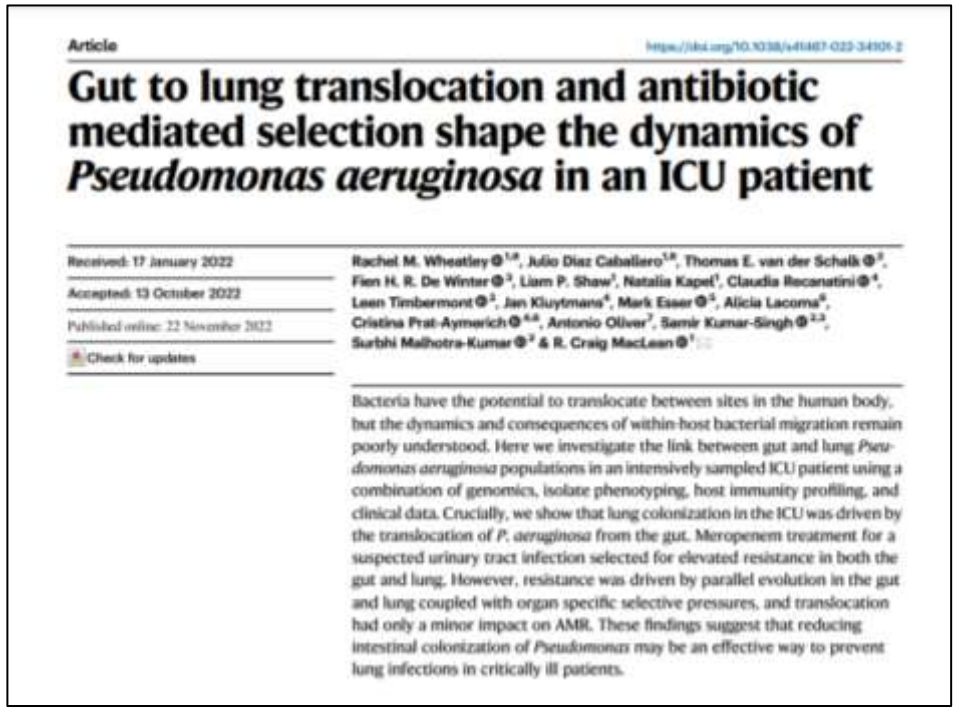
ADOPTED: 1 December 2016

doi: 10.2903/j.efsa.2017.4665

## Risk for the development of Antimicrobial Resistance (AMR) due to feeding of calves with milk containing residues of antibiotics

EFSA Panel on Biological Hazards (BIOHAZ),
Antonia Ricci, Ana Allende, Declan Bolton, Marianne Chemaly, Robert Davies, Pablo Salvador Fernández Escámez, Rosina Girones, Kostas Koutsoumanis, Roland Lindqvist, Birgit Nørrung, Lucy Robertson, Giuseppe Ru, Moez Sanaa, Marion Simmons, Panagiotis Skandamis, Emma Snary, Niko Speybroeck, Benno Ter Kuile, John Threlfall, Helene Wahlström, Björn Bengtsson, Damien Bouchard, Luke Randall, Bernd-Alois Tenhagen, Eric Verdon, John Wallace, Rosella Brozzi, Beatriz Guerra, Ernesto Liebana, Pietro Stella and Lieve Herman

"…Consumption of such milk will lead to increased faecal shedding of antimicrobial-resistant bacteria by calves…"



Article

https://doi.org/10.1038/s41467-022-34904-2

# Gut to lung translocation and antibiotic mediated selection shape the dynamics of *Pseudomonas aeruginosa* in an ICU patient

Received: 17 January 2022
Accepted: 13 October 2022
Published online: 22 November 2022
Check for updates

Rachel M. Wheatley[1,8], Julio Diaz Caballero[1,8], Thomas E. van der Schalk[2], Fien H. R. De Winter[2], Liam P. Shaw[3], Natalia Kapel[1], Claudia Recanatini[4], Leen Timbermont[2], Jan Kluytmans[4], Mark Esser[2], Alicia Lacoma[5], Cristina Prat-Aymerich[6,7], Antonio Oliver[7], Samir Kumar-Singh[2,3], Surbhi Malhotra-Kumar[2] & R. Craig MacLean[1]

Bacteria have the potential to translocate between sites in the human body, but the dynamics and consequences of within-host bacterial migration remain poorly understood. Here we investigate the link between gut and lung *Pseudomonas aeruginosa* populations in an intensively sampled ICU patient using a combination of genomics, isolate phenotyping, host immunity profiling, and clinical data. Crucially, we show that lung colonization in the ICU was driven by the translocation of *P. aeruginosa* from the gut. Meropenem treatment for a suspected urinary tract infection selected for elevated resistance in both the gut and lung. However, resistance was driven by parallel evolution in the gut and lung coupled with organ specific selective pressures, and translocation had only a minor impact on AMR. These findings suggest that reducing intestinal colonization of *Pseudomonas* may be an effective way to prevent lung infections in critically ill patients.

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Home 〉 News 〉 First evidence drug resistant bacteria can travel from gut to lung, increasing infection risks

# First evidence drug resistant bacteria can travel from gut to lung, increasing infection risks

PUBLISHED
22 NOV 2022

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BIOLOGY HEALTH MATHEMATICAL, PHYSICAL AND LIFE SCIENCES RESEARCH SCIENCE

A new Oxford University study released during World Antimicrobial Awareness Week has significant findings on how antimicrobial resistance (AMR) arises and persists. The results, published today in *Nature Communications*, provide the first direct evidence of AMR bacteria migrating from a patient's gut microbiome to the lungs, increasing the risk of deadly infections.

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# Environment

Food and Agriculture Organization of the United Nations

World Health Organization

**FAO/WHO expert meeting on foodborne antimicrobial resistance:**

**Role of environment, crops and biocides**

**Rome, 11-15 June 2018**

**Summary Report**

**1. Introduction**

In recognition of the growing problem of antimicrobial resistance (AMR), its increasing threat to human, animal and plant health, and the need for a One Health approach to address this issue, the 39th Session of the Codex Alimentarius Commission (CAC) agreed it was important for the food safety community to play its part and re-established the *ad hoc* Codex intergovernmental Task Force on Antimicrobial Resistance (TFAMR)[1] with the objectives of the Task Force revising the current *Codex Code of Practice to Minimise and Contain Antimicrobial Resistance* (CAC/RCP 61-2005)[2] and to developing new guidance on surveillance programmes relevant to foodborne AMR.

Responding to the request from the CAC and the Task Force to provide scientific advice in the areas of crops, environment and biocides,[3] the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) convened, in collaboration with the World Organisation for Animal Health (OIE), a joint "FAO/WHO expert meeting on foodborne antimicrobial resistance: role of environment, crops and biocides" on 11-15 June 2018 in Rome, Italy. The list of participants is given in Annex 1.

The primary purpose of the meeting was to synthesize the current scientific literature concerning the transmission of antimicrobial-resistant bacteria, antimicrobial residues and antimicrobial resistance genes (ARGs) from environmental sources (e.g. contaminated water, soil, manure or human wastes, fertilizers, processing and transportation facilities) to foods and feeds of plant and aquatic animal origin. As a secondary goal, given the widespread and frequent use of disinfectants in food processing plant sanitation, the potential of biocides to co-select for AMR and ARGs was also reviewed. Non-food crops (e.g. cotton, flower bulbs) were excluded from this scope.

[1] REP16/CAC
[2] CAC/RCP 61-2005
[3] REP18/AMR

Joint FAO/WHO Expert Meeting on Foodborne Antimicrobial Resistance: Role of the Environment, Crops and Biocides 1

## Soil:

"…***manure*** *or other organic material that contains* ***human or animal wastes*** *used as soil amendments, have the potential to disseminate both residues of antimicrobial agents and AMR bacteria to the environment…*"

"*…of concern is the possibility of selection of AMR bacteria and ARGs through the process of* ***co-resistance, cross-resistance and co-regulation*** *with certain* ***metal ions****. Evidence indicates that contamination of soil with certain metal ions, such as copper ions, promotes AMR in soil bacteria*"

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# Environment

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[1] REP16/CAC
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[3] REP18/AMR

Joint FAO/WHO Expert Meeting on Foodborne Antimicrobial Resistance: Role of the Environment, Crops and Biocides 1

## Water:

"…*there is a direct link between water quality used for irrigation and AMR bacteria on foods…*"

"…*wastewater effluent recovered from municipal sewage may contain ARGs and AMR bacteria…*"

"…*soils irrigated with wastewater can also become contaminated with ARGs and with multidrug AMR bacteria…*"

*pathogens*

MDPI

*Review*

## The Effects of Feeding Waste Milk Containing Antimicrobial Residues on Dairy Calf Health

**Clair L. Firth *, Katrin Kremer, Thomas Werner and Annemarie Käsbohrer**

Unit of Veterinary Public Health and Epidemiology, Institute of Food Safety, Food Technology & Veterinary Public Health, University of Veterinary Medicine, 1210 Vienna, Austria
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**Abstract:** A number of studies have reported that there is a high prevalence of antimicrobial-resistant faecal bacteria excreted by dairy calves. Although faecal shedding is influenced by a variety of factors, such as the environment and calf age, feeding milk with antimicrobial residues contributes significantly to an increased prevalence of antimicrobial-resistant (AMR) bacteria, such as extended spectrum beta-lactamase (ESBL)-producing *E. coli*. As a follow-up to the European Food Safety Authority (EFSA) Scientific Opinion on the risk of AMR development in dairy calves published in January 2017, this review aims to illustrate more recent research in this area, focusing on the period 2016 to 2020. A total of 19 papers are reviewed here. The vast majority assess the commensal faecal bacteria, *E. coli*, isolated from dairy calves, in particular its antimicrobial-resistant forms such as ESBL-producing *E. coli* and AmpC-producing *E. coli*. The effect of waste milk feeding on the prevalence of pathogens such as *Salmonella* spp. has also been investigated. Current research findings include positive effects on daily liveweight gain and other advantages for calf health from feeding waste milk compared to milk replacer. However, the negative effects, such as the demonstrable selection for antimicrobial-resistant bacteria, the shift in the intestinal microbiome and the possible negative consequences that these could have on global public health, should always be taken into consideration.

**Keywords:** cattle; antimicrobial resistance; mastitis; dairy; *Escherichia coli*; veterinary public health; waste milk; antibiotics


# Relevance of mastitis control to contain AMR

- Prevention of mastitis
- New sustainable methods for the use of wasted milk
- What is in it for farmers? Health.

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# Thank you!

*Jorge Pinto Ferreira*
jorge.pintoferreira@fao.org

http://www.fao.org/antimicrobial-resistance/en/