536
2025

Bulletin

of the International Dairy Federation

IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2.0

with technical support of
World Organisation for Animal Health

IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2.0

Published by the International Dairy Federation (IDF) AISBL, Silver Building, Boulevard Auguste Reyers 70/B, B-1030 Brussels, Belgium.
www.fil-idf.org

Edition published in August 2025
Issue number/edition: 536/2025
ISSN 0250-5118

Required citation:
International Dairy Federation. (2025). *The IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2.0* (Bulletin of the IDF N° 536/2025).
https://doi.org/10.56169/HECI1752

This bulletin was produced by the IDF Standing Committee on Animal Health and Welfare. The IDF publication process ensures a high degree of scientific quality. This process includes review and approval steps that incorporate diverse forms of knowledge and expertise from the dairy sector worldwide. The IDF Science and Programme Coordination Committee oversees all IDF work. Find out more about the IDF publication process here.

Abstract

Antimicrobial resistance is an urgent global health challenge, and if left unaddressed, has the risk of growing out of control. The fluid nature of the microbial genome means that activities in either the medical, veterinary, or environmental sectors are likely to have impacts on each of the others. In this context, the livestock production sector is taking steps towards more targeted antimicrobial use, with the dairy sector leading the efforts. All stakeholders, namely farmers, veterinarians, food processing, pharmaceutical, distribution, stock feed producers and competent authorities have roles to play to support antimicrobial stewardship. The revised guide lists some of the steps that each of these groups can take in this effort. For the dairy farmers and the veterinarians, the focus lies in effective disease prevention and appropriate treatment and maintaining high levels of biosecurity and overall animal husbandry. Food processing companies support this effort through quality assurance frameworks. Pharmaceutical manufacturers and distributers, stockfeed producing companies are involved through Good Manufacturing Practices (GMP) and the supply of approved, high-quality antimicrobials. Finally, steps from the competent authorities are aimed at regulating and monitoring the use of antimicrobials and surveillance of antimicrobial resistance.

Keywords

Antimicrobial resistance, antimicrobial agents, residues, Good Agricultural Practices

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Foreword by the International Dairy Federation

Laurence Rycken
Director General
International Dairy Federation

Antimicrobial resistance (AMR) has been declared by the World Health Organization as one of the top ten global health threats and in the absence of strong global, regional and national responses, it was estimated to be directly responsible for 1.27 million human deaths in 2019 and indirectly responsible for 4.95 million human deaths in the same year. Antimicrobials, critical to preserve human health, are also an essential tool to maintain the welfare and productivity of livestock worldwide. The overuse and misuse of antimicrobials by all users accelerates the development of AMR resulting in reservoirs of AMR-microbes that may be transmitted to humans via direct contact, via the environment or via food animals.

The International Dairy Federation (IDF), representing the global dairy sector, recognizes the importance of prompt and effective action to address the emergence and spread of AMR. In September 2024, global leaders met for the 79th United Nations General Assembly (UNGA) High-Level Meeting on Antimicrobial Resistance (AMR) and committed to a clear set of targets and actions to address AMR. The declaration, titled the 2024 UN Political Declaration on AMR, includes commitments pertaining to human health, agriculture and animal health and the environment across several policy areas. The revised IDF Guide supports the implementation of four key commitments for the animal health sector: (1) meaningfully reduce the quantity of antimicrobials globally used in agri-food systems, (2) ensure their prudent and responsible use in line with international standards, (3) prioritizing disease prevention strategies, especially vaccination, and (4) investing in veterinary services to enhance animal health systems. The prudent, responsible, and evidence-based use of antimicrobials is a key activity under the declaration against which the International Dairy Federation (IDF) Guide to Prudent Use of Antimicrobials is aligned.

The guide promotes responsible antimicrobial use in dairy farming, emphasizing stewardship, surveillance, and preventive practices to reduce reliance on antibiotics.

By advocating for best practices in dairy production across the supply chain, infection prevention, and alternative treatments, the IDF contributes to the One Health approach, which recognizes the interconnectedness of human, animal, and environmental health. This supports the Quadripartite (Food and Agriculture Organization of the United Nations, FAO; United Nations Environment Programme, UNEP, World Health Organisation, WHO; and World Organisation for Animal Health, WOAH;) Global Action Plan, helping to mitigate AMR risks while ensuring food safety and sustainable dairy production.

Laurence Rycken
Director General
International Dairy Federation
August 2025

Foreword by the World Organisation for Animal Health

Dr Emmanuelle Soubeyran
Director General
World Organisation for Animal Health

Drug-resistant pathogens could jeopardise food security for over two billion people. This alarming projection, drawn from the EcoAMR Series Reports co-published by the World Organisation for Animal Health (WOAH) and the World Bank, makes it clear that antimicrobial resistance (AMR) is far more than a health issue. It is a critical threat to global food systems, rural livelihoods and sustainable development.

In response, global leaders adopted the second Political Declaration on AMR at the United Nations General Assembly in September 2024. This ambitious agreement outlines 45 commitments across all sectors. The animal health sector, in particular, has a leading role to play: reducing antimicrobial use, ensuring prudent and responsible practices, prioritising prevention, including vaccination strategies, and investing in essential veterinary services. These are not optional; they are essential steps towards safeguarding human and animal health systems.

WOAH is committed to helping its Members meet these goals through the implementation of its international standards, technical support and global monitoring systems such as the Animal Antimicrobial Use Global Database (ANIMUSE). In May 2024, the World Assembly of WOAH Delegates adopted the updated Chapter 6.10. of the *Terrestrial Animal Health Code*, which provides comprehensive guidance on the responsible and prudent use of antimicrobial agents in animals. In the same vein, in July 2025, work is underway to update its twin chapter in the *Aquatic Animal Health Code*.

AMR is a One Health challenge that requires joint action across all sectors. Our collective ability to prevent the spread of resistant pathogens depends on the responsible use of antimicrobials in all domains, especially in food-producing animals.

This is why WOAH is proud to partner with the International Dairy Federation (IDF) on this revised Guide to Prudent Use of Antimicrobial Agents in Dairy Production. The dairy sector, with its global reach and essential role in nutrition and livelihoods, is well positioned to lead on antimicrobial stewardship. This guide brings our standards to life by translating principles into practice for veterinarians, farmers and professionals on the ground.

WOAH welcomes the emphasis in this guide on preventive strategies including improved husbandry practices, biosecurity and vaccination, as reflected in WOAH's *List of priority diseases for which vaccines can reduce antimicrobial use*. The guide also highlights the *WOAH List of Antimicrobial Agents of Veterinary Importance* and encourages responsible decision-making

based on surveillance and data, using tools such as ANIMUSE and our Global Alert System for Substandard and Falsified Veterinary Products.

This is a moment for leadership, partnership and accountability. The dairy sector can and must be a champion for responsible antimicrobial use. Together, we can safeguard both animal and human health, now and for generations to come.

We count on you.

Dr Emmanuelle Soubeyran
Director General
World Organisation for Animal Health (WOAH)
August 2025

Acknowledgements

The IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2.0 updates the previous IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production (2013).

IDF would like to express its sincere gratitude for the invaluable contributions of the members of the Standing Committee on Animal Health and Welfare, under the leadership of the Action Team on Antimicrobial Resistance Guide Update led by David Kelton (University of Guelph, Canada). We also extend our thanks to the main contributors to this report: Lynda McDonald (TetraPak, Sweden), Michael Shallcrass (Fonterra, New Zealand), Stephanie Bullen (Dairy Australia, Australia), Jamie Jonker (National Milk Producers Federation, United States), Morgan Jeannin (World Organisation for Animal Health – WOAH), Daniela Battaglia (Food and Agriculture Organization of the United Nations – FAO), Jorge Pinto Ferreira (Food and Agriculture Organization of the United Nations – FAO), Alfonso Zecconi (Universita degli Studi di Milano, Italy), Dishon Muloi (International Livestock Research Institute – ILRI, Kenya), Biruk Alemu Gemeda (International Livestock Research Institute – Kenya), Samantha Tennent (WelFarm, New Zealand), Theo Lam (GD Animal Health, Netherlands), and Volker Kroemker (Hochschule Hannover, Germany).

IDF also wishes to thank the members of the Action Team on the Update of the IDF Guidance on Antimicrobial Resistance (AMR): Norma Arrigoni (Italy), Laerke Boye Astrup (Denmark), Mark Chimes (South Africa), Tennielle Ellingham (New Zealand), Michael Farre (Denmark), Himanshu Gupta (Nestlé, Switzerland), A.V. Harikumar (India), Annabel Harris (New Zealand), April Johnson (World Organisation for Animal Health – WOAH), Yoshio Kiku (Japan), Ilka Klaas (Denmark), Åsa Lundberg (Sweden), Marcos Munoz Domon (Chile), Marit Smistad (Norway) and Javier Yugueros-Marcos (World Organisation for Animal Health – WOAH).

The support of the project from the Science and Programme Coordination Committee, the IDF National Committees, as well as María Sánchez Mainar and Panagiotis Galatsanos from the IDF Head Office, is particularly acknowledged. Appreciation is also extended to the Food and Agriculture Organization (FAO), the World Organisation for Animal Health (WOAH), and the International Livestock Research Institute (ILRI) for their thorough review of the document prior to publication.

Abbreviations

AMR	Antimicrobial Resistance
AMU	Antimicrobial Use
FAO	Food and Agriculture Organization
GMP	Good Manufacturing Practices
GAP	Good Agricultural Practices
HACCP	Hazard Analysis and Critical Control Point
IDF	International Dairy Federation
MRL	Maximum Residue Limit
NAP	National Action Plan
QA	Quality Assurance
R&D	Research and development
WOAH	World Organisation for Animal Health

1. Introduction

1.1. Background

The emergence of multidrug-resistant bacteria is posing challenges to health professionals and communities around the world for both human and animal health, establishing it as one of the leading global One Health problems. Antimicrobial resistance occurs when commonly used antimicrobial agents are no longer effective against the target bacteria and so pose a risk to both animals and people, particularly children, the elderly and those with poorly functioning immune systems. Antimicrobial agents play an indispensable role in supporting animal health, welfare and productivity. At the same time, the need for prudent use is obvious to ensure food safety and to reduce the risk of antimicrobial resistance and its negative impact on animal and human health.

Throughout the years, the global dairy sector has been very much aware of the need for responsible antimicrobial use and many countries have implemented proactive measures throughout the dairy supply chain.

Integrated supply chain management approaches now adopted by the dairy industry require ownership and cooperation by all participants - dairy farmers, veterinarians, dairy and meat processing companies, pharmaceutical companies, distributors, stock feed producers, and competent authorities – to help prevent the emergence and transmission of antimicrobial resistance.

The *IDF Guide to Prudent Use of Antimicrobial Agents* has been prepared and updated to provide a generic framework to support the responsible use of antimicrobial agents in dairy production. The guidelines recognize that dairy farms supply both milk and meat for human consumption and that a coordinated, whole of supply chain approach is required to manage the food safety risks associated with modern food production.

This document focuses on desired outcomes, rather than on prescriptive actions or processes. These outcomes align with WOAH's international standards on responsible and prudent antimicrobial use, as outlined in Chapter 6.10 of the Terrestrial Animal Health Code. This document provides examples of recommended practices for all participants that participate in the production, distribution, supply, use and regulation of antimicrobial agents used on dairy farms. These examples effectively manage the risks posed by using antimicrobial agents across the whole supply chain, are achievable, and are currently being implemented in many parts of the world. It is recognized that not all the recommended practices included in this Guide may be relevant/implementable in all the circumstances and that relevant recommended practices may be identified from the Guide for implementation as appropriate to the local dairy production

system. For ease of reading, the term 'herd' is used throughout the document, but is intended to apply inclusively to groups of sheep, goats, camels, and buffaloes as well.

The guide highlights the role of:

- Dairy farmers in managing animal health and husbandry practices to minimize the occurrence and spread of disease
- Veterinarians providing antimicrobial use (AMU) oversight and appropriate prescribing to ensure that the most appropriate treatments are used correctly as well as expert advice on herd health plans
- Food (dairy and meat) processing companies in setting and following clear specifications for the raw products they source, establishing traceability systems and in verifying and monitoring farmer compliance
- Pharmaceutical companies in ensuring that antimicrobial agents are properly manufactured, assessed, including post-market authorization, labelled, and then only sold through regulated distribution channels. In addition, access to quality and safe products should be ensured
- Distributors in protecting the integrity of said distribution channels, reporting substandard and falsified products
- Competent authorities in effectively controlling the manufacture, registration, supply, and use of antimicrobial agents, and in having effective systems in place to monitor antimicrobial use and resistance.

The focus of this guide is on measures aiming to limit the development of antimicrobial resistance to veterinary medicines, and the term 'antimicrobial' is used rather than 'antibiotic' to be consistent with the global definition established by the Quadripartite Joint Secretariat on AMR. The scope of this document does not include equipment cleaning disinfectants or teat disinfectants.

1.2. Guiding objective for prudent use of antimicrobial agents on dairy farms

The guiding objective is that milk and meat should be produced from healthy animals under accepted agricultural and welfare conditions, with minimal and controlled use of antimicrobial agents. An integrated whole supply chain approach is needed to achieve this.

Guiding principles for the practices are that antimicrobial use should be evidence-based and science informed. Practically, that creates the responsibility of all stakeholders to either participate or support the dissemination of knowledge on topics relevant to AMR and prudent AMU, relevant to scientific understanding, regulations, or policies. Competent authorities and pharmaceutical companies are tasked with promoting and supporting training programs on prudent antimicrobial use and raising awareness on antimicrobial resistance. Farmers, veterinarians, and distributors are encouraged to participate in these programs, but also support

them through their professional organizations. In the context of training, it is important that all people overseeing or administrating veterinary medicinal products, including antimicrobial agents, are appropriately trained to perform the tasks to ensure proper hygiene and safety for both animals and humans.

Other general measures concern the traceability and sourcing of the medicines. Everyone along the supply chain should keep records of antimicrobial supply and use, and obtain veterinary medicinal products only from authorized and regulated sources, if present, to prevent the inclusion of substandard and falsified medicines in the chain that could be detrimental to both animal and human health. Records should be kept at each level of the supply chain and in a manner that enables them to be simply collated and used to monitor AMU.

When selecting an antimicrobial agent, the dispensing of the most critical antimicrobials, as categorized by the World Health Organization (2024), the WOAH List of antimicrobial agents of veterinary importance (2025) and/or relevant regional authority, should be avoided in all but exceptional circumstances where no other alternative exists. When deciding on the scope of the animals receiving treatment, the selective or targeted approach should always take precedence over blanket treatment, assuming it is the most appropriate approach to preserve animal health, animal welfare or food safety. In management systems where blanket therapy is considered the best option, changes to the management system should be made to eliminate the need for blanket AMU.

Each actor in the supply chain has requirements specific to their field.

Dairy farmers should apply Good Agricultural Practices (GAP) in:

- Herd foundation and management
- Internal and external biosecurity
- Milking techniques and hygiene
- Nutrition
- Animal health management, including vaccination programs and responsible AMU.

Veterinarians (or appropriate authorized technical advisors) should assist dairy farmers to apply GAP by providing:

- Advice on the management of animal health, especially preventive measures that can reduce the need to use antimicrobial agents, as part of an overall herd health plan
- Diagnostic services including advice on suitable and effective treatment protocols based on appropriate diagnostic tests
- Appropriate administration and/or supply of antimicrobial agents either directly or under prescription
- Appropriate labelling of antimicrobial medicines supplied
- Advice on the appropriate use of antimicrobial agents, including dose, frequency, route, and duration of administration, recording of treatments, identifying treated animals, and observing appropriate withdrawal periods for milk and meat

Food (dairy and meat) processing companies should provide support to dairy farmers through:

- Establishing and promoting specifications for acceptable raw products
- Providing technical support to farmers about animal health and welfare standards required by their company.
- Monitoring of incoming raw products supplied using screening tests to prevent food safety concerns and ensure they are suitable for processing into food products
- Undertaking follow-up investigative and corrective actions if raw products do not meet specifications and reporting relevant information and advice to farmers
- Applying control measures for microbiological hazards

Pharmaceutical companies should reduce the risks related to antimicrobial agents by:

- Following manufacturing practices to ensure production of efficacious, safe, and quality veterinary medicinal products
- Implementing measures for the safe disposal of pharmaceutical waste to avoid environmental contamination
- Providing relevant and appropriate information on labels and data sheets
- Collecting information on the after-market performance of their products, most notably on the development of AMR
- Collaborating with competent authorities to provide data on antimicrobial use (AMU) to support surveillance and risk management efforts
- Ensuring access to and availability of treatment options to ensure adequate tools for prevention and treating diseases, in all market sizes
- Investing in research and development, including vaccine development, guided by existing lists of diseases for which vaccines could reduce antimicrobial use in food-producing animals, WOAH (2018).

Distributors, wholesalers, and stockfeed manufacturers have tasks that include:

- Ensuring that only legitimate and registered products are used in the supply chain
- Producing safe and clearly identified medicated feed without causing cross-contamination with other feed.

Competent authorities should underpin the prudent use of antimicrobial agents on dairy farms by:

- Organizing efforts to control the emergence of AMR by establishing and implementing a National Action Plan
- Assessing the risks and regulating the types of antimicrobial treatments available for supply and use
- Ensuring all antimicrobial drugs/medicinal products are registered according to transparent criteria before being placed on the market
- Approving the appropriate dose rate and withdrawal period for all classes of dairy livestock
- Licensing appropriately qualified veterinarians to prescribe antimicrobial agents and supervising their competencies
- Implementing systems to monitor the quantities of antimicrobial agents used in dairy livestock
- Monitoring AMR to licensed products in their jurisdiction.

1.3. Presentation of the guide

The Guide includes tables of GAP and suggested measures for each key supply chain participant – dairy farmers, veterinarians, food (milk and meat) processing companies, pharmaceutical companies, distributors, wholesalers and stockfeed manufacturers and competent authorities. When a document containing further information has been identified, it will be mentioned to assist the reader in expanding into the subject.

The guide includes general principles that should be applicable to any dairy production environment. Professional organizations are invited to adapt the present advice to their field conditions and create specific to their area of work guiding documents.

2. Definitions

Animal health management: means a system designed to optimize the physical and behavioral health and welfare of animals. It includes the prevention, treatment and control of diseases and conditions affecting the individual animal and herd or flock, including the recording of illness, injuries, mortalities, and medical treatments where appropriate. (WOAH, 2024b)

Antimicrobial agents: agents used to prevent, control, and treat infectious diseases in humans, animals, and plants. They include antibiotics, fungicides, antiviral agents and parasiticides. Disinfectants, antiseptics, other pharmaceuticals, and natural products may also have antimicrobial properties but are not included in the definition. (Quadripartite Joint Secretariat on AMR, n.d.)

Antimicrobial resistance: occurs when bacteria, viruses, fungi, and parasites no longer respond to antimicrobial agents. Because of drug resistance, antibiotics and other antimicrobial agents become ineffective and infections become difficult or impossible to treat, increasing the risk of disease spread, severe illness and death. (Quadripartite Joint Secretariat on AMR, n.d.)

Antibiotic: means any substance with a direct action on bacteria that is used for treatment or prevention of infections or infectious diseases. (European Commission, 2018)

Antimicrobial residues: small quantities of the antimicrobial agent(s) and/or their metabolites in any edible portion of animal products, including residues of associated impurities of the veterinary treatments concerned.

Biosecurity: means a set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections, or infestations to, from and within an animal population. (WOAH, 2024b)

Competent authority: the government authority or official body authorized by the government that is responsible for the setting of regulatory food safety requirements and/or for the organization of official controls including enforcement. (Joint FAO/ WHO Codex Alimentarius Commission, 2022)

Contaminant: any biological or antimicrobial agent, foreign matter or other substance not intentionally added to food that may compromise food safety or suitability. (adapted from Codex Alimentarius, 2022)

Dosage regimen: dose, frequency of dosing, route, and duration of administration. (WOAH, 2024c)

Feed: means any material (single or multiple), whether processed, semi-processed or raw, which is intended to be fed directly to terrestrial animals. (WOAH, 2024b)

First-line antimicrobial: an antimicrobial that is the first choice for treating a particular infectious disease because it is considered a very effective treatment for that condition with the least likelihood of potential consequences to public health of increased antimicrobial resistance when used in animals and the need for their use in veterinary medicine.

Maximum residue limit: the maximum concentration of residue legally tolerated in a food product obtained from an animal that has received a veterinary medicine. (Joint FAO/ WHO Codex Alimentarius Commission, n.d.)

Off-label use: (also called extra-label use) the use of an antimicrobial agent that is not in accordance with the approved product labelling. (Joint FAO/ WHO Codex Alimentarius Commission, 2021)

One Health approach: an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are linked and inter-dependent. The approach mobilizes multiple sectors, disciplines, and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development. (One Health High-Level Expert Panel, 2023)

Pathogen: a micro-organism that can cause infection, illness, or disease. (Joint FAO/ WHO Codex Alimentarius Commission, 2021)

Prudent antimicrobial use: is determined by taking into account the importance of the antimicrobial agent to veterinary and human medicine, the risk of development of antimicrobial resistance, the specifications detailed in the relevant regulatory approval and the indications for use, including off-label use, when antimicrobial agents are administered to animals. (WOAH, 2024c)

Unregistered antimicrobial agent: medical products that have not undergone evaluation and/or approval by the National or Regional Competent Authority for the market in which they are marketed/distributed or used, subject to permitted conditions under national or regional regulation and legislation. (WHO, 2017)

Withdrawal period: (also called withholding period, or for milk sometimes discard time) means the minimum period between the last administration of a veterinary medicinal product to an animal and the production of foodstuffs from that animal which under normal conditions of use is necessary to ensure that such foodstuffs do not contain residues in quantities harmful to public health. (European Commission, 2018)

Vaccination: means the administration of a vaccine, in accordance with the manufacturer's instructions and the Terrestrial Manual, when relevant, with the intention of inducing immunity in an animal or group of animals against one or more pathogenic agents. (WOAH, 2024b)

Veterinarian: means a person with appropriate education, registered or licensed by the relevant veterinary statutory body of a country to practice veterinary medicine/science in that country. (WOAH, 2024b)

Veterinary paraprofessional: a person who is authorized by the veterinary statutory body to conduct certain designated tasks (dependent upon the category of veterinary paraprofessional) in a territory and delegated to them under the responsibility and direction of a veterinarian. (adapted from WOAH, 2024b)

Veterinary medicinal product: any product with approved claims to having a prophylactic, therapeutic or diagnostic effect or to alter physiological functions when administered or applied to an animal. (WOAH, 2024b)

3. Good practices

3.1. Dairy farmers

Dairy farmers are responsible for the health and welfare of their livestock. Applying GAP on dairy farms can reduce the need to use antimicrobial agents.

Good dairy farming practices have been described in the *FAO and IDF Guide to Good Dairy Farming Practice* (FAO & IDF, 2011), which was later updated and republished (IDF, 2019). Key practices that support the prudent use of antimicrobial agents on farms are collated in the table below.

Good dairy farming practices	Examples of suggested measures that underpin the prudent use of antimicrobial agents on dairy farms	Objective of measures
1.1 Establish the herd with resistance to disease	1.1.1 Choose breeds and animals well suited to the local environment and farming system 1.1.2 Determine herd size and stocking rate based on management skills, local conditions and the availability of land, infrastructure, feed, and other inputs	Ensure the structure of the farm is optimal for disease and stress prevention
1.2 Prevent entry of disease onto the farm (external biosecurity plan)	1.2.1 If necessary to add animals to your herd, only buy animals of known health status (both herd and individual animals) and control their introduction to the farm, using pre-movement testing and/or quarantine if indicated 1.2.2 Ensure that animal transportation on and off the farm does not introduce disease 1.2.3 Monitor risks from adjoining land and have secure boundaries 1.2.4 Limit access of people and wildlife to the farm and where access of people is required, have them follow established biosecurity protocols 1.2.5 Have a vermin and pest control program in place 1.2.6 Only use clean equipment 1.2.7 Vaccinate all animals as recommended or required by local animal health authorities and the herd veterinarian	Maintain farm external biosecurity preventing new pathogens from entering Keep animals healthy Comply with international, national, and regional regulations on animal movement and disease controls

Good dairy farming practices	Examples of suggested measures that underpin the prudent use of antimicrobial agents on dairy farms	Objective of measures
1.1 Have an effective herd health management program in place	1.3.1 Develop, implement, and document an effective farm herd health management program focused on prevention that meets farm needs as well as regional and national requirements, in consultation with a veterinarian 1.3.2 Use an identification system that allows all animals to be identified individually from birth to death 1.3.3 Regularly check all animals for signs of disease 1.3.4 Establish diagnostic and recommended treatment protocols as prescribed and advised by a veterinarian, to ensure that sick animals are identified promptly and treated quickly and appropriately 1.3.5 Isolate sick animals, when appropriate, to avoid the transfer of pathogens to other animals 1.3.6 Keep records of all diagnoses, treatments, the use of antimicrobials and deaths or removal from the herd. Identify treated animals appropriately. Review it regularly and if required, share information with the competent authority. 1.3.7 Monitor and record treatment outcomes and follow country-specific requirement on reporting treatment failures and adverse reactions to the competent authority 1.3.8 Be aware that some diseases pose a risk to humans; and take measures to prevent human exposure 1.3.9 Ensure newborn animals receive adequate quantity and quality of colostrum within 24 hours of birth 1.3.10 Ensure animals are kept in a safe environment that minimizes stress 1.3.11 Manage animals to minimize pain, injury, and disease, and respond promptly to issues 1.3.12 Control parasites (helminths, ticks, and flies) and other vectors that have the potential to spread bacterial diseases	Detect and act on animal diseases early Prevent the spread of disease among animals in the herd Ensure food safety and traceability Establish high level of animal welfare

Good dairy farming practices	Examples of suggested measures that underpin the prudent use of antimicrobial agents on dairy farms	Objective of measures
1.4 Use all antimicrobial agents and veterinary medicinal products as directed	1.4.1 Only use veterinary medicinal products, including antimicrobial agents, approved for supply and use under relevant legislation 1.4.2 Purchase veterinary medicinal products only from authorized and regulated sources 1.4.3 Ensure that the person administrating the antimicrobial agents is appropriately trained to perform the task 1.4.4 Take measures to ensure that administration of veterinary medicinal products is performed in a hygienic manner 1.4.5 When the weight of the animal is relevant to the dose, calculate the weight as accurately as possible 1.4.6 Use all veterinary medicinal products according to label directions (dose, frequency of dosing, route, and duration of administration), unless otherwise indicated in writing by a veterinarian or a competent authority. 1.4.7 Comply with meat/milk withdrawal periods as stated on the label or as advised in writing by a veterinarian or competent authority. 1.4.8 Store antimicrobial agents and veterinary medicinal products securely and properly. 1.4.9 Dispose of antimicrobial agents responsibly. Consider them as medical waste and dispose of according to veterinary or regulatory instructions – do not reuse expired or leftover veterinary medicinal products	Take steps to ensure effective and safe treatment Prevent occurrence of antimicrobial residues in milk and meat

Good dairy farming practices	Examples of suggested measures that underpin the prudent use of antimicrobial agents on dairy farms	Objective of measures
1.5 Ensure milking routines do not injure the animals, expose the animals to pathogens or introduce contaminants into milk	1.5.1 Use best practice in the harvest of milk to minimize exposure and transmission of pathogens 1.5.1 Identify individual animals that require special milking management 1.5.1 Segregate milk harvested from sick or treated animals, for appropriate disposal 1.5.1 Do not feed waste milk from treated adults to offspring	Ensure milking practices do not contribute to the spread of pathogens Prevent the introduction of contaminants into milk
1.6 Ensure animal feed and water are of suitable quantity and quality	1.6.1 Ensure the nutritional and water needs of animals are met 1.6.1 Veterinary medicinal products administered through feed and water should comply to the requirements of part 1.4 1.6.1 Avoid feeding products originating from any sources that may contain antimicrobial residues 1.6.1 Feed and water should be sourced, stored, and administered in a way that avoids contamination of any kind	Keep animals healthy with good quality feed and water Avoid contamination with antimicrobial agents due to practices in nutrition
1.7 Ensure dairy farming practices do not have the potential to increase the frequency of antimicrobial resistance in animals and the environment	1.7.1 Contain dairy effluent on the farm 1.7.1 Use veterinary products appropriately to avoid unnecessary risks of development of resistance in animals and contamination of the animal-related environment	Limit the impact of dairy farming practices on the environment and the pool of antimicrobial resistant microorganisms

3.2. Veterinarians

Veterinarians have a key role in ensuring the prudent supply of antimicrobial agents for dairy farms. They are responsible for supporting animal health and welfare, as well as identifying, preventing, and treating animal diseases. The promotion of sound animal husbandry practices, hygienic procedures, biosecurity, and vaccination strategies, where relevant, can help to minimize the need for antimicrobial use in food-producing animals. The prescribing veterinarian should be familiar with the health status of the livestock being treated to ensure that the antimicrobial agents used are appropriate. The veterinarian must also ensure that clear directions are given to the people administering the treatments and managing the livestock, with reference to the required dosage regimen and withholding periods. Finally, the veterinarian should regularly study and evaluate the advice they have provided, and the outcomes of the treatments described.

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
2.1 Assess the requirements for antimicrobial treatment	2.1.1 Prescribe only for animals in herds under your care, of which you are aware of the disease situation 2.1.2 Diagnose the condition requiring antimicrobial treatment by considering the animal's history, clinical signs, and results of reliable, accurate and validated diagnostic tests 2.1.3 Do not administer antimicrobials as a part of a treatment protocol if there is no expectation of successful cure by the antimicrobials 2.1.4 Consider the use of efficacious alternatives to antimicrobials to reduce the reliance of antimicrobials 2.1.5 Work continuously to implement/ review preventive and other measures to minimize the need to use antimicrobial agents 2.1.6 Avoid the use of antimicrobial agents to compensate for inadequate animal husbandry practices	Only supply antimicrobial agents when and where necessary Ensure the antimicrobial agents prescribed will be effective for the condition being treated Antimicrobial agent use is minimized

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
2.2 Select an appropriate antimicrobial product for the circumstances	2.2.1 Avoid the use of critically important antimicrobials whenever possible in compliance with national, regional and WOAH guidelines 2.2.2 Select first-line antimicrobial products that have proven efficacy for the disease being treated whilst minimizing risks to the animal and the consumer and the occurrence of AMR 2.2.3 Only use combinations of antimicrobial agents that are complementary and approved by the competent authority for use together 2.2.4 Prescribing or using antimicrobial agents off-label must only be undertaken if permitted under national legislation, properly justified and if the risks can be adequately managed 2.2.5 Prescribing or using unregistered antimicrobial agents must only be undertaken if permitted under national legislation and if the risks can be adequately managed	Most effective treatment is used and spread of infection minimized Antimicrobial resistance is reduced Take account of the guidance documents in antimicrobial selection
2.3 Give clear advice on the appropriate use of the antimicrobial agent	2.3.1 Follow the information of the product label when prescribing and/or administering antimicrobial agents unless alternative treatment protocols are scientifically justified 2.3.2 Give clear, herd specific written instructions to persons that are responsible for administering antimicrobial agents about dosage regimen, method of hygienic administration, appropriate storage, and meat/milk withdrawal periods 2.3.3 Label all medicines supplied according to national legislation 2.3.4 Access the herd record of diagnoses, treatments, and antimicrobial use. Review them regularly and if required, share information with the competent authority	Antimicrobial agents are used appropriately with minimal risks to people, livestock, or food safety

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
2.4 Review treatments	2.4.1 Periodically review the health and AMR status of livestock being treated and the appropriateness of antimicrobial agent therapies 2.4.2 Routinely evaluate the outcome of treatment protocols and revise as needed 2.4.3 Monitor and record treatment outcomes and follow country-specific requirement on reporting treatment failures or unexpected outcomes to the competent authority 2.4.4 Keep antimicrobial use records, preferably in an electronic format that can be easily collated and quantified periodically	Problems with health and antimicrobial use are identified and investigated

3.3. Food processing companies

Food (dairy and meat) processing companies play an important part in supporting farmers to use antimicrobial agents in accordance with the veterinarian's instructions. That can be by encouraging the participation in antimicrobial stewardship initiatives, such as monitoring and reporting of antimicrobial use. They should set clear specifications and expectations of suppliers and check the raw products received against these criteria, with penalties for non-compliance. Systems must also be in place to exclude supplies from processing that do not meet compliance criteria.

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
3.1 Provide clear specifications for raw products and the quality management systems	3.1.1 Implement a documented and auditable food safety/quality assurance system for all suppliers 3.1.2 Provide clear specifications for purchasing raw products from suppliers and consider having an incentive and/or penalty system to foster compliance 3.1.3 Audit/assess the effectiveness of on-farm food safety/quality assurance systems regularly 3.1.4 Implement requirements to encourage farmers to participate in antimicrobial stewardship initiatives, including monitoring and reporting of antimicrobial use 3.1.5 Support farmers to improve their animal health and antimicrobial use	Farmers are using antimicrobials judiciously, and aware of buying/ accepting specifications and the consequences or penalties for non-conformance

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
3.2 Detection and exclusion of contaminated supplies	3.2.1 Provide guidance for milk residue testing 3.2.2 Undertake residue screening of raw products 3.2.3 Ensure screening tests have the appropriate spectrum to cover the risk profile of raw milk 3.2.4 Screen incoming supplies at processing facilities 3.2.5 Testing of end-product and prompt investigation and reporting of positive test results to competent authorities according to requirements	Residues are detected quickly Causes of failures identified Minimize the risks of contaminated supply leaving the farm and entering the factory Minimize microorganisms in food Foodborne transfer of antimicrobial resistance is minimized
3.3 Adopt a HACCP-based risk management system for microbiologi-cal hazards	3.3.1 Assess microbiological hazards for foodborne AMR and apply relevant control measures e.g., hygiene, heat treatment and temperature control	

3.4. Pharmaceutical companies

All antimicrobial agents used for veterinary purposes on dairy farms are sourced from pharmaceutical companies. These companies are in a prime position to ensure that the antimicrobial agents used on farms are of high quality, safe and efficacious and packaged with clear instructions for the user. Pharmaceutical companies need to collaborate with competent authorities to ensure that each antimicrobial product is subject to a comprehensive risk assessment prior to being approved for supply and use on farms, and then provide appropriate aftermarket support for their products. Antimicrobial agents must be manufactured in accordance with Good Manufacturing Practices (GMP).

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
4.1 Provide the necessary information to allow the scientific assessment of antimicrobial products for efficacy and safety	4.1.1 Generate and provide all the required information/data to allow antimicrobial products to be assessed by the competent authority when applying for regulatory approval 4.1.2 Provide competent authorities with data on the type and amount of antimicrobial agents being manufactured and/or marketed	All relevant information on the efficacy and safety, as well as the quantity of agents sold should be provided to the competent authorities
4.2 Supply regulated channels with antimicrobial agents of quality	4.2.1 Ensure antimicrobial agents supplied are appropriately registered and approved by the competent authority before being marketed and supplied 4.2.2 Use GMP in the manufacture of antimicrobial agents 4.2.3 Supply only licensed and officially approved veterinary medicinal products through authorized and regulated channels 4.2.4 Incentives that have a financial value to prescribers or suppliers for the purpose of increasing the use or sales of medically important antimicrobials should not occur 4.2.5 Advertising and marketing of antimicrobial agents directly to dairy farmers must follow regulations	High quality, genuine antimicrobial agents are judiciously dispensed to farmers by competent professionals
4.3 Support and monitor supply and oversee after-market product performance	4.3.1 Take steps to ensure the availability of veterinary medicinal products and cooperate with the competent authority to forecast and avoid any product shortage 4.3.2 Have systems in place to receive feedback from product users such as treatment failures or adverse reactions 4.3.3 Actively investigate and resolve problems reported with antimicrobial agent use 4.3.4 Support industry and/or authorities to implement a pharmaco-vigilance program and antimicrobial use (AMU) and AMR surveillance aligned with national frameworks and international standards where applicable	Issues with antimicrobial use are actively monitored and investigated Emerging AMR issues are promptly identified and reported to competent authorities

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
4.4 Invest in Research and Development (R&D)	4.4.1 Invest in relevant R&D to develop vaccines for priority diseases, diagnostic tests, in-feed nutritional products, immunostimulants, genetic evaluation tools and alternative therapies to reduce the need to use antimicrobials for the control and treatment of disease in animals 4.4.2 Invest in the development and supply of new antimicrobial actives	Reduce the need for antimicrobials to control and treat disease in animals

3.5. Distributors, wholesalers, and stock feed manufacturers

Wholesale and retail distributors play a part in prudent antimicrobial use as they have the duty to guard the integrity of the supply chain. Stock feed manufacturers need to control the relevant risks, most notably cross contamination during production, as well as ensure proper information is distributed.

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
5.1 Ensure that legitimate and registered products progress through the supply chain	5.1.1 Report any suspected or confirmed substandard or falsified veterinary medicinal products to the competent authorities	The market is kept free of substandard or falsified veterinary medicinal products
5.2 Medicated animal feed manufactured according to quality requirements and is safe to use	5.2.1 When manufacturing medicated feed, ensure that only approved sources of medications are added at a level, and for a species and purpose as permitted by the medicated premix label or a veterinary prescription 5.2.2 Ensure that medicated animal feed is labelled with the appropriate information 5.2.2 Implement appropriate production practices to prevent cross-contamination of other feed	Medicated feed contains appropriate ingredients Label provides information on safe use Non-medicated feed does not contain antimicrobials

3.6. Competent authorities

The prudent use of antimicrobial agents on dairy farms is underpinned by competent authorities ensuring that the antimicrobial agents present in the market are safe and efficient. The regulatory system controlling antimicrobial supply and use should be supporting One Health by monitoring antimicrobial use and resistance, and promoting standard processes aligned with these aims. Finally, controls in all stages of production need to occur to ensure that users are complying with the requirements on supply and use.

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
6.1 Establish a National Action Plan aiming to protect animal health and prevent the development and spread of AMR	6.1.1 Contribute to the development and implementation of a National Action Plan following a One Health approach to promote the responsible and prudent use of antimicrobial agents and control AMR 6.1.2 Draft and publish guidance on best farm management practices for the protection of animal health 6.1.3 Collect and publish information on antimicrobial supply and use from all parts of the distribution chain 6.1.4 Monitor for changes in antimicrobial agent susceptibility of selected microorganisms from food, animals and clinical samples 6.1.5 Update the plan based on the information collected and scientific evidence	Set up a plan to support animal production, monitor antimicrobial usage and resistance

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
6.2 Assess the suitability of antimicrobial agents for use in dairy animals prior to registration	6.2.1 Establish criteria for the market registration and publish guidelines on the technical requirements 6.2.1 Conduct a thorough and evidence-based risk assessment of the applications, based on which regulatory approval of veterinary medicinal products is provided 6.2.1 Establish maximum residue limits in food products 6.2.1 Establish withholding periods for milk and meat 6.2.1 Assess post-marketing antimicrobial resistance surveillance programs, reviewing the product registration in the light of surveillance data, adverse reports of the antimicrobial's use and scientific evidence	Provide direction and transparency for the requirements of a market authorization Safe and efficient treatments are registered for use Relevant information is on product labels and data sheets for farmers, veterinarians and distributors Registration of agent is reviewed after field use of animal treatments or reported concerns
6.3 Implement controls over the supply of antimicrobial agents	6.3.1 Monitor the entire supply chain to prevent fraud and ensure compliance with regulatory requirements on quality, safety and efficacy 6.3.2 Regulate and supervise the advertisement of antimicrobial agents 6.3.3 Restrict the supply of antimicrobial agents to regulated supply chain participants and ensure controls on supply are adhered to 6.3.4 Regulate veterinarians and veterinary paraprofessionals as appropriate	The supply of antimicrobial agents of satisfactory quality is managed by regulated antimicrobial supply chain participants in accordance with national legislation Veterinarians are knowledgeable about the requirements on antimicrobial prescription
6.4 Implement controls over the use of antimicrobial agents on dairy farms	6.4.1 Ensure compliance with regulatory and manufacturer and/ or veterinary instructions on antimicrobial usage, handling and disposal 6.4.2 Monitor milk, milk products and meat for the presence of antimicrobial residues and resistant pathogens	Ensure compliance with regulatory requirements that effectively manage the risks of antimicrobial use on dairy farms

Good practices to ensure the prudent use of antimicrobial agents on dairy farms	Examples of suggested measures to support dairy farmers in the prudent use of antimicrobial agents	Objective of measures
6.5 Ensure the availability of antimicrobial agents	6.5.1 Act in partnership with the pharmaceutical industry to ensure access to and availability of required antimicrobial agents in all markets	The required veterinary medicine is always available in the market

4. Conclusions

There are actions that each stakeholder can take when aiming to align antimicrobial usage in the dairy sector with the goal of reducing and limiting the spread of AMR.

Dairy producers implement the management system, which is the key factor influencing the need for antimicrobial agents, and thus have the strongest effect on the goal of prudent antimicrobial usage. They can take measures ensuring that the animals are living in optimal conditions, protecting animal health and welfare to ensure that the risk of disease is minimized through a thorough herd health management plan, and when treatment is necessary, that occurs according to up-to-date veterinary advice in a safe way. Veterinarians need to ensure that the decision on antimicrobial usage is evidence-based, occurs according to the requirements of guidelines for responsible use and national legislation, GAP, as well as support the establishment of an effective herd health management plan.

Other relevant actors have been identified. Food processing companies can play a practical role in encouraging and supporting farmers to use antimicrobials judiciously, while also ensuring that dairy products undergo rigorous testing to meet or exceed safety standards before reaching the market Pharmaceutical companies help these efforts by developing quality medicines, sharing information regarding their supply and safety including AMR with the competent authorities, following requirements on marketing and distribution to improve access to essential veterinary medicinal products and ongoing investment in R&D, such as vaccines that could reduce the need for antimicrobial use and contribute to improved animal health. Distributors and wholesalers can protect the supply chain from substandard and falsified medicines. Stockfeed manufacturers have a responsibility to ensure that their products are of quality, safe and efficacious and supply medications according to veterinary prescription.

Finally, the competent authorities should develop and support implementation of a National AMR Action Plan, working closely together with other relevant sectors in a One Health approach. The implementation of a National AMR Action Plan should include monitoring and surveillance systems for AMU and AMR, ensure that antimicrobial supply and usage in all parts of the chain takes place in accordance with relevant legislation and control AMR. The timely and thorough evaluation, as well as revision, if necessary, of the products in the market is an important task.

Thus, all members of the dairy supply chain have a responsibility to control AMR through the prudent use of antimicrobials and are expected to use this document as a reference to guide their actions and implement appropriate measures.

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The IDF Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2.0 was elaborated by a project group composed of experts, members of the IDF Action Team on Antimicrobial Resistance as well as representatives of the Food and Agriculture Organization (FAO), World Organisation for Animal Health (WOAH) and International Livestock Research Institute (ILRI). The objective of the guide is to promote prudent use of antimicrobial agents in dairy production. These practices must be based on science and consider parameters which are relevant and essential to dairy farming.

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