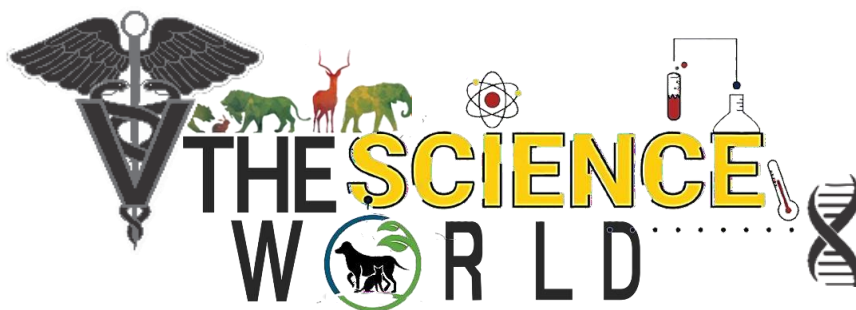




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When Medicine Enters The Food Chain: *The Hidden Story Behind Antibiotic Use in Dairy Animals*

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Abstract

Milk is a part of our everyday diet, but its safety begins long before it reaches the consumer. Dairy animals may require antibiotics to treat bacterial infections and protect their health. Problems can arise when medicines are used unnecessarily or incorrectly, treatment records are not maintained, or milk is collected before the required withdrawal period has ended. In such cases, veterinary drug residues may remain in milk and become a food-safety concern. At the same time, inappropriate antimicrobial use can contribute to antimicrobial resistance (AMR), making some infections more difficult to treat. Although antibiotic residues and AMR are different issues, both highlight the need for responsible use of medicines in dairy animals. This article explains how medicines can enter milk, why withdrawal periods are important, and how proper treatment, record keeping, milk handling and monitoring help prevent unacceptable residues from entering the food chain. It also discusses the wider AMR challenge through a One Health perspective, linking animal, human and environmental health. Overall, safe milk depends on responsible decisions from treatment on the farm to the point of consumption.

Keywords: antimicrobial residues; antimicrobial resistance; dairy animals; withdrawal period; antimicrobial stewardship; One Health

1. Introduction

Every morning, millions of people begin their day with a glass of milk, a cup of tea, curd or another dairy product. We usually see milk as a simple and nutritious food, but before it reaches our kitchen, it has already passed through a much longer journey involving the animal, veterinary care, farming practices, milk collection and processing. One part of this journey often remains unseen: the medicines given to the animal that produced the milk.

Like humans, dairy animals can develop bacterial infections and may need antibiotics for treatment. When used correctly under veterinary guidance, these medicines are important for



animal health and welfare. Problems can arise when antibiotics are used unnecessarily, treatment instructions are not followed or milk is collected before the required withdrawal period has ended. In such cases, drug residues may remain in the milk and enter the food chain. Antibiotic residues and antimicrobial resistance (AMR) are different concerns, but both show why responsible use of antibiotics matters. Residues are mainly a food-safety issue, while AMR can make infections harder to treat in animals and people.

The withdrawal period is one of the important safeguards in this process. It is the time that must pass after treatment before milk from the animal can be used for human consumption. During this period, the milk is kept out of the food supply while drug residues decrease to acceptable levels. Importantly, milk containing residues may look, smell and taste completely normal, so the problem cannot be identified simply by looking at the milk.

Safe milk, then, is not just about what happens in the kitchen. It begins much earlier with responsible treatment of animals, proper records, careful handling of milk and attention to food-safety rules. Understanding this journey helps us see how a simple glass of milk connects animal health, food safety and public health.

2. Where Does the Story Begin? When a Dairy Animal Needs Treatment

The story begins not with the glass of milk, but with the animal that produces it. Dairy animals can develop bacterial infections that affect their health, comfort and productivity. Mastitis, for instance, is a common condition in which the udder becomes inflamed and may require antimicrobial treatment when a bacterial infection is involved. Antibiotics have an important role in veterinary care when they are genuinely needed, helping to control infection, reduce suffering and support recovery. The concern is not the use of antibiotics itself, but their unnecessary or inappropriate use. Before treatment, the likely cause of illness and the choice of medicine, dose, route and duration need to be considered with veterinary guidance. Not every illness requires an antibiotic, and unnecessary treatment offers little benefit while adding to the wider problem of antimicrobial resistance.

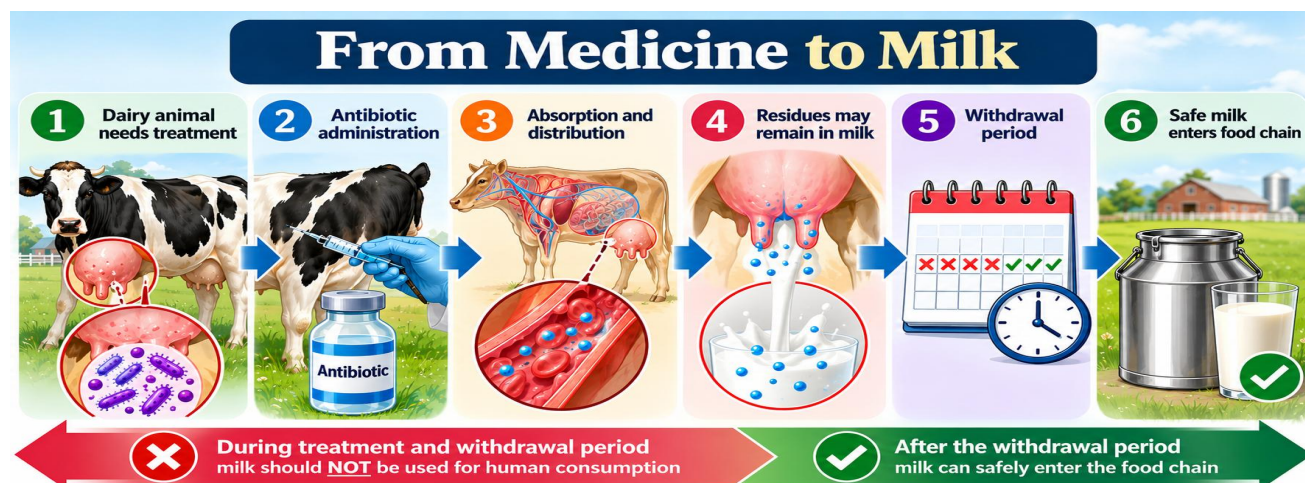
Keeping animals healthy can also reduce the need for antimicrobial treatment. Good hygiene, suitable housing, adequate nutrition, vaccination, biosecurity and early recognition of disease can help prevent infections or limit their spread. When treatment is necessary, careful use of the medicine and proper attention to the prescribed dose and duration are important. Once an antibiotic has been given, the next part of the story begins inside the animal: the medicine is absorbed, distributed and eventually eliminated from the body. This raises an important food-safety question can any part of the medicine remain in the milk, and if so, how long does it take before that milk is safe to enter the food chain?



3. From Medicine to Milk: What Happens After Treatment?

When a dairy animal is given an antibiotic, the medicine starts working inside its body. It moves through the blood and tissues and is slowly removed from the body. During this time, small amounts of the medicine or the substances formed when the body breaks it down may remain in the milk. These are called antibiotic residues. Finding residues in milk for some time after treatment does not always mean that the medicine was used wrongly. The concern arises when the amount is higher than the safe limit or when the milk is collected before the required waiting time is over. How long the medicine stays in milk depends on the type of antibiotic, the dose given, how it was given and the animal itself. An animal may look healthy again, but that does not always mean that its milk is ready to be used. Some medicine may still be present even after the animal has recovered.

For this reason, milk from a treated animal needs to be kept separate until the required waiting period is over. Farmers should also keep a record of which animal was treated, which medicine was given and when the treatment took place. Such records can help prevent milk from a treated animal from accidentally being mixed with other milk. The waiting period gives the medicine enough time to leave the animal's body and for the amount left in the milk to fall to a safe level. But what exactly is this waiting period, and how do we know when the milk can safely return to the food chain?



From antibiotic treatment to milk: the role of residues and the withdrawal period

4. The Waiting Period: Why Can't the Milk Go to Market Yet?

After an animal receives antibiotic treatment, its milk cannot always be used immediately. The withdrawal period is the required time between the last dose of medicine and when the milk can safely be used for human consumption. It allows drug residues in the milk to fall to acceptable levels. The withdrawal period is different for different medicines and depends on factors such as



the drug, dose, formulation, route of administration and the animal. Farmers should follow the period given on the medicine label or by a veterinarian rather than estimate it themselves.

During this time, milk from the treated animal must be kept out of the food supply and separate from milk meant for sale. Recording the animal, medicine used, treatment date and withdrawal end-date can help prevent accidental mixing. The animal may appear completely healthy before the withdrawal period is over, but this does not mean its milk is ready for consumption. The full withdrawal period must be completed to help prevent unacceptable drug residues from entering the food chain.

There is one difficulty, though: milk under a withdrawal period may look, smell and taste perfectly normal. So how can we know whether unwanted residues are present?

5. It Looks Like Normal Milk-So What's the Concern?

Antibiotic residues cannot be reliably detected by looking at, smelling or tasting milk. Milk containing a veterinary drug residue may look completely normal, which is why safety cannot be judged at home. The possible health effects depend on the medicine, the amount present and how often a person is exposed. Some residues may cause allergic reactions in sensitive people, while certain medicines can have other harmful effects at higher levels. This does not mean that every trace of an antibiotic in milk will make someone ill. The main concern is when residues are above the safety limits set for food or when a medicine is not permitted for use in food-producing animals.

To protect consumers, food-safety authorities set maximum residue limits (MRLs) for approved veterinary medicines. These limits define the amount of a residue that can remain in food without posing an unacceptable risk when the medicine is used correctly. Boiling milk should not be treated as a way to remove antibiotic residues. Heating may reduce some medicines but may have little effect on others, so milk from an animal still within its withdrawal period should not be used simply because it has been boiled. In India, milk is also tested through food-safety surveillance programmes to detect veterinary drug residues and help strengthen controls in the dairy supply chain.

For consumers, the presence of antibiotic residues is not a reason to fear every glass of milk. Proper use of veterinary medicines, following withdrawal periods and regular monitoring are important safeguards. But antibiotic residues and antimicrobial resistance are two different issues. Why, then, are they so often discussed together?

6. Two Stories, Often Confused: Residues and Resistance

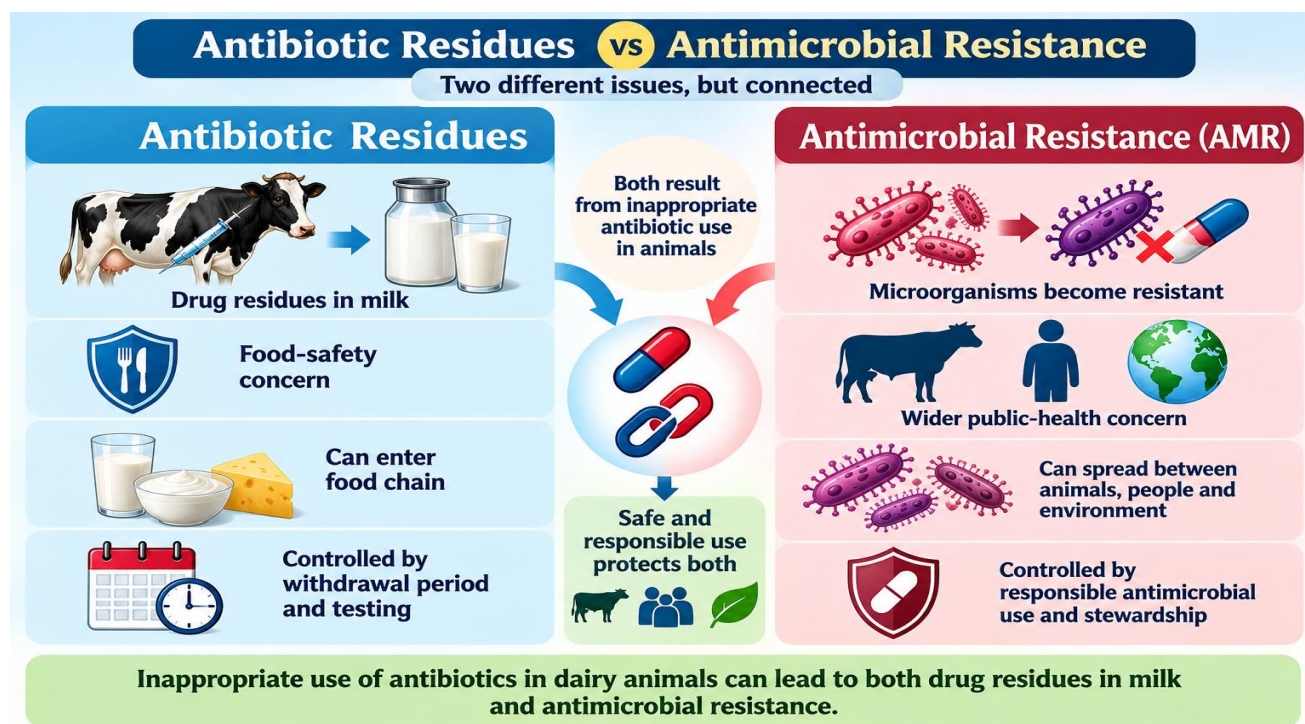
Antibiotic residues and antimicrobial resistance (AMR) are often discussed together, but they are not the same thing. An antibiotic residue is the medicine, or a substance produced from



it, that remains in milk after an animal has been treated. It is mainly a food-safety issue. The concern is whether the residue is permitted and whether its level is within the established safety limit. AMR is different. It occurs when microorganisms become less sensitive to medicines that once worked against them, making some infections harder to treat in animals and people.

The two problems can, however, be linked to the way antibiotics are used. Unnecessary or inappropriate use of antibiotics can encourage resistance, while failing to follow the withdrawal period can allow unacceptable residues to enter the food supply. Their control therefore requires different measures. Residues are controlled through correct veterinary drug use, proper withdrawal periods and testing of food products. AMR is addressed through responsible antibiotic use, disease prevention, good hygiene, infection control and appropriate treatment.

Laboratory findings also need to be interpreted carefully. Finding an antibiotic-resistant bacterium in milk does not prove that antibiotic residues are present. In the same way, finding a drug residue does not mean that the bacteria in that milk are resistant to the drug. The two issues are separate, but AMR deserves particular attention because when antibiotics stop working effectively, the consequences can extend well beyond the farm or a single glass of milk. The next question is how antibiotic use in animals can contribute to this wider problem.



Antibiotic residues and antimicrobial resistance: two distinct but connected concerns

7. When Medicines Stop Working: The Bigger AMR Challenge

When antimicrobial medicines stop working well against an infection, treatment can become more difficult, costly and time-consuming. In dairy farming, unnecessary or incorrect use



of antibiotics can favour microorganisms that are less sensitive to these medicines. Such microorganisms may remain in animals or their surroundings and make future infections harder to treat. For farmers, this may mean an animal takes longer to recover, needs a different medicine or requires repeated veterinary care. The result can be higher treatment costs, longer illness and reduced animal productivity and welfare.

The problem can also move beyond a single animal or farm. Resistant microorganisms can spread between animals, people and the environment through contact, food and environmental pathways, making AMR a One Health concern. The World Health Organization estimated that bacterial AMR was directly responsible for about 1.27 million deaths globally in 2019 and was associated with about 4.95 million deaths. These figures represent the overall human-health burden of bacterial AMR and should not be taken as deaths caused specifically by antibiotic use in dairy animals.

For dairy farming, antibiotics remain important when animals genuinely need treatment, but their effectiveness needs to be protected. Preventing disease, using medicines responsibly and following veterinary advice can help reduce unnecessary antibiotic use. A dairy farm is not an isolated system; animals, farmers, food, water and the environment are all connected. That is why responsible antibiotic use on the farm matters beyond the farm itself.



The One Health connection between animals, people, antimicrobial resistance and the environment

8. Who Keeps the Milk Safe? From Farm to Food Chain

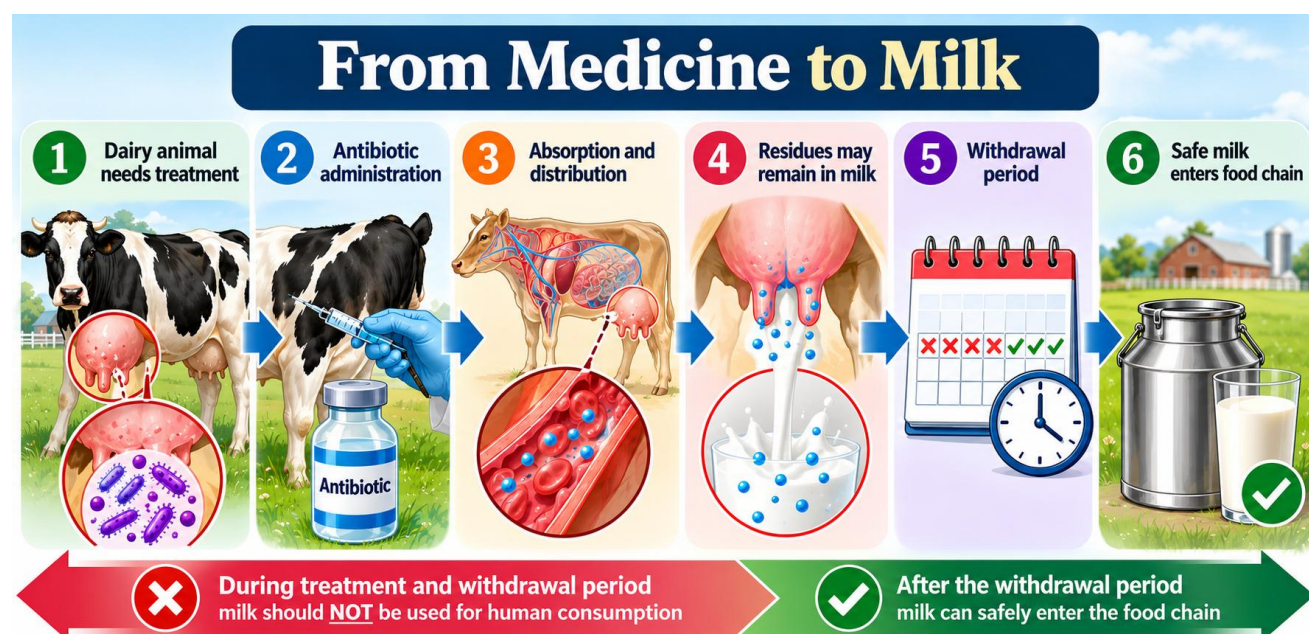
Keeping milk safe is not the responsibility of one person. It begins on the farm and continues through veterinary care, milk collection, processing, testing and regulation. Farmers are



often the first to notice when an animal is unwell, and early veterinary advice can help avoid unnecessary antibiotic use. When treatment is needed, the medicine should be used as advised, with records of the animal, medicine, dose, treatment date and withdrawal end-date. Animals under withdrawal should be clearly identified, and their milk kept separate from milk meant for sale.

Preventing infection is just as important as treating it. Good milking hygiene, mastitis control, vaccination, suitable housing, proper nutrition and biosecurity can reduce disease and the need for antibiotics. If an animal does not respond to treatment, veterinary reassessment and, when needed, diagnostic testing can help determine the next step. Beyond the farm, milk collection centres and dairy processors need systems to keep milk under withdrawal out of the bulk supply. Laboratories and regulatory authorities support this process through residue testing, surveillance and enforcement of food-safety standards.

A safe dairy system does not mean keeping antibiotics away from animals. It means using them when they are needed, following the withdrawal period and having checks in place to keep unsafe milk out of the food chain. By the time milk reaches the breakfast table, it has passed through a chain of decisions and safeguards that most consumers never see.



Farm-to-fork safeguards for maintaining milk safety

Conclusion: Safe Milk Begins Before the Glass

A glass of milk may look simple, but its safety depends on decisions made long before it reaches the consumer. Using antibiotics only when needed, treating animals appropriately and following the required withdrawal period all play an important role in keeping milk safe.



Antibiotic residues and antimicrobial resistance are different problems, but both show why responsible antibiotic use matters. Keeping milk with unacceptable residues out of the food supply protects consumers, while using antibiotics carefully helps preserve their effectiveness for animals and people.

Safe milk does not begin in the kitchen. It begins on the farm with healthy animals, responsible treatment and careful decisions that protect animal health, food safety and public health.

References

- Codex Alimentarius Commission. (2024). *Maximum residue limits (MRLs) and risk management recommendations (RMRs) for residues of veterinary drugs in foods (CXM 2-2024)*.
- Food and Agriculture Organization of the United Nations. (n.d.). *Environment: Antimicrobial resistance*.
- Food Safety and Standards Authority of India. (2022). *Milk surveillance report 2022*.
- World Health Organization. (2024). *Antimicrobial resistance: Accelerating national and global responses (WHA77.6)*.
- World Organisation for Animal Health. (2024). *Terrestrial Animal Health Code: Chapter 6.10: Responsible and prudent use of antimicrobial agents in veterinary medicine*

