Milk, meat, and manure: Farmer perceptions of antibiotic residue reservoirs

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ANTIBIOTIC residues and resistance are quickly becoming focal areas in animal agriculture, especially in dairy farming. Antibiotic residues have been found in soils, surface waters, and groundwaters, and even though animal agriculture is not the sole contributor to global antibiotic resistance, attention to this area is growing in importance.

To understand farmer perceptions of these emerging contaminants, we conducted an interview study of central New York dairy farms that varied in management classification, farm size, and farmer age. Our goal was to understand the pathways farmers associated with these contaminants so we can better mitigate future environmental pollution.

Antibiotics leaving the farm

Antibiotic usage on dairy farms has declined dramatically over the past several decades. However, despite this reduction, antibiotic resistance in the environment is a growing threat to both human and livestock medicine.

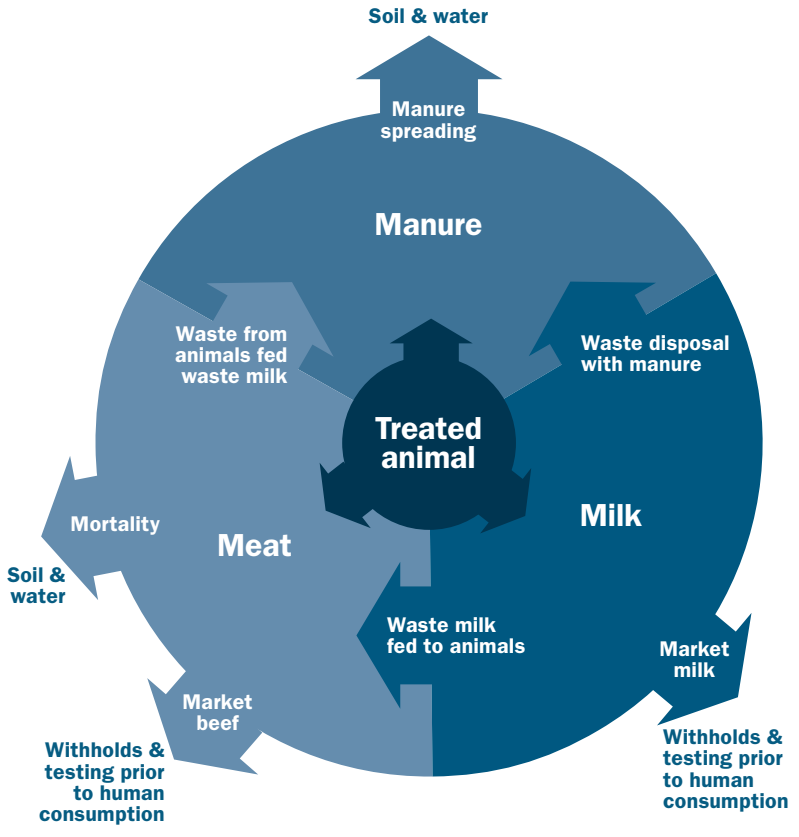
Antibiotic residue transport off farms is one source of environmental contamination. There are two main areas to mitigate this contaminant:

1. Reduce the amount of antibiotics used through good animal husbandry, nonantibiotic treatments, and testing,
2. Implement waste reduction technologies to minimize the spread of antibiotic residues and resistant bacteria.

After an animal is treated, antibiotics can go into one of three reservoirs: milk, meat, and/or manure. A large fraction of the antibiotic — research shows 50% to 90% depending on antibiotic type — is excreted chemically unchanged. Chemically unchanged antibiotics can also accumulate in milk, muscle, and fatty tissue. Due to the complex nature of operations on a dairy farm, these reservoirs then interact with other cows, soil, and water systems through a network of residue transfers.

For example, waste milk from a treated cow may be fed to a calf that then incorporates the residue into their meat and excretes it with their manure. Internally, sustained low doses of antibiotics may alter the gut microbiome. Externally, antibiotic residues in manure can interact with soil organisms, be transported with sediment and water, and eventually enter surface water supplies where they interact with aquatic life and can enter human drinking water supplies.

Some waste mitigation strategies reduce the transport of antibiotic residues and resistant bacteria. In general, manure and mortality disposal systems that employ high heat, including aerobic composting, high temperature digestions, and bedding recovery units, likely reduce residues to a greater extent than more common manure management systems such as lagoons, and daily spreading. The high temperatures can encourage breakdown of residues and kill some resistant bacteria.



What farmers had to say

Due to strict regulations and testing, we found farmers frequently considered transport of antibiotics into milk and meat. However, the story of antibiotic movement on farms is complex and involves more pathways than simply market products.

Farmer perceptions of antibiotic transport into marketed milk varied most across management classifications. One farmer shared a perception common to organic management, explaining, "I think there are three antibiotic [classes] that got tested for in our milk. Right? But how many antibiotics are there, that we can use? So do I worry? Yeah, [I'm] worried."

Conventional farmers tended to vary significantly in their perceptions of antibiotic contamination in market milk. We found this variability to align with farmer ages in the millennial (born 1981 to 1996), Gen X (born 1965 to 1980), and baby boomer (born 1946 to 1964) age groups.

Baby boomers tended to have the perspective "There's no antibiotic that goes into the food stream via milk," while Gen X farmers were more likely to highlight their complex antibiotic tracking systems to

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avoid contamination. Millennial farmers tended to emphasize on-farm testing of milk. This group said they "always test it here until it's negative" before returning milk to the bulk tank.

Perceptions of antibiotic residue transport into marketed beef were more homogeneous across our study categories. While motivations to prevent carcass contamination varied between social and economic pressures, all farmers identified transport through meat as an important pathway of antibiotics moving off farms.

What about waste milk?

The practice of feeding waste milk to calves was widespread across categories of interviewed farmers. However, perceptions of antibiotic residue transport through waste milk varied greatly. Some farmers displayed low levels of concern, stating, "I'm not concerned about the level of antibiotics that would be in the waste milk, because we dilute that anyways."

Others explained it in a more nuanced approach, saying, "It all depends on how heavily we dose the cow. If the cow is sick, we do not feed the milk to the calves. If it's on the upswing and we haven't given the animal any antibiotics in a couple days, we'll start feeding the calves." Still others explained that waste milk "does have some [antibiotic] residue in it, so you can't use that milk for calves that we plan on selling."

Feeding waste milk from animals treated with antibiotics cycles chemically active antibiotic residues into other animals. This may have short- and long-term impacts on animal health and farm-wide microbial resistance.

Some waste milk is disposed of in manure storage systems, which harbor and degrade antibiotic residues and resistant bacteria to varying degrees, depending on the system, additionally impacting farm-wide resistance. Farmer perceptions of antibiotic residue transport in manure were most visibly defined between management practices of organic and conventionally managed farms.

Organic farmers were more likely to state, "It is in our manure. You give whatever to an animal, it comes out somewhere. It wasn't until [we went] organic that I realized all the microscopic activity in a handful of soil." Conventional farmers were more likely to express, "In terms of the manure, I know it happens. I guess I don't consume any time with it because I don't know how you could control it at this point."

None of the farmers we interviewed discussed antibiotic transport with carcass disposal. This is a pathway in which residues can certainly reach the environment that farmers can impact.

Mitigate the spread

The pathways antibiotics can travel on-farm are interconnected in many ways, but they also have downstream effects with other human systems. In order to reduce environmental contamination by antibiotics, we must consider these relationships and the nuances with different management practices.

Animal agriculture, and indeed the dairy industry itself, has made great strides to reduce total usage of antibiotics. Recognizing the interplay these compounds have on the environment, however, is the next step to further mitigate the spread of antibiotic residues and antibiotic resistance.

WWW. More farmer perspectives and the full study summary can be found at on.hoards.com/residueperceptions.