Antibiotic Usage & Pathways: On-Farm Perspectives from CNY Dairy Producers

By Christine Georgakakos, Cornell University Department of Biological and Environmental Engineering, and Betsy Hicks, CCE South Central NY Dairy and Field Crops Program

This article is part of a series, written from a peer-reviewed article entitled "*Farmer perceptions of dairy farm antibiotic use and transport pathways as determinants of contaminant loads to the environment"* published in the Journal of Environmental Management (https://doi.org/10.1016/j.jenvman.2020.111880). The work focused on twenty-seven interviews of dairy farmers in Central NY March through October of 2019, completed and summarized by the authors. Eight of the farms included managed their farms according to USDA Certified Organic standards, and the remaining nineteen farms managed their farms conventionally. Farm size ranged from under 50 mature cows to over 1000 mature cows. This series talks about the nuances between farm size and management, specific to findings interesting to the dairy farmer. This article highlights farmer perspectives of antibiotic usage on-farm as well as subsequent pathways of antibiotics after administration to their herd.

Contaminants of emerging concern

Pharmaceuticals, pesticides, and other emerging contaminants have been gaining attention across agricultural, environmental, and public health sectors. Slowly, we have expanded our understanding of the broader impacts of these compounds and how they can potentially move in our food, water, soil and air. As consumers as well as farmers, many of us contribute to the movement of some of these compounds into the environment on a daily basis, whether through ingredients in cleaning supplies, laundry detergents, or yard and lawn products, as well as the prescriptions and over the counter drugs we take or give to our pets or livestock to alleviate ailments. It comes as no surprise that agriculture is scrutinized as a potential source of pharmaceutical contamination – our industry is widespread and many antibiotics are dosed on a per-weight basis. We aim to use our findings from the interviews to help inform any future potential regulation so that the agricultural industry is better understood by policy makers, as well as uncover areas where the ag industry could feasibly implement strategies to help mitigate potential environmental contamination from farms.

Dairy products: milk and meat

Use of pharmaceuticals in animal agriculture has focused on reducing antibiotic residues in food products. As such, there are strict regulations to which farmers must adhere to ensure the antibiotic concentration in animal food products falls under the required levels. Regulations like the Veterinary Feed Directive (VFD), improved veterinary client patient relationships (VCPR), and required prescriptions for antibiotic usage have all dramatically reduced the amount of antibiotics used in animal agriculture. In our study, not surprisingly, we found that tracking antibiotic usage as a means to minimize and eliminate milk and meat residues is a part of day to day operations for many dairy farmers. We also found that the systems used for tracking cows treated with antibiotics varied between farmer ages. Gen X farmers were very concerned with

antibiotic presence in meat and milk and stressed the animal tracking systems that they use to ensure milk separation. One Gen X farmer we spoke with stated that with tracking, *"One of the things we're super sensitive to is making sure we stay on top of [documenting usage]. I created a book with anytime an animal gets treated with anything that has a withhold. So we put it in here. Anytime an animal gets sold or moved, we make sure we know exactly what's been in them."* Millennial famers tended to emphasize on-farm testing, with one millennial conventional farmer stating *"Well, there is a level of antibiotics in milk, you know. It's just whether it's met that [testing] threshold."* Several millennial farmers we spoke with highlighted the practice of *"always test[ing] it here until it's negative"* before returning a treated cow's milk to the bulk tank.

The tracking, testing, and required withhold time seems to have pushed some dairy farmers away from using antibiotics at all. One organic dairy farmer told us, *"Well we don't have to worry about contaminating our milk and our beef. We don't have to watch withholding times and so for that, that's a big thing. And mistakes happen"*, as antibiotic usage is prohibited in animals producing organically marketed products. But regardless of management practice or farmer age, farmers highlighted their efforts to minimize antibiotic usage. While the reasons to reduce antibiotic usage varied across farm size and practice, the outcome of reducing antibiotic usage remained consistent across the industry. Organic producers tended to align with the ideology of contaminant reduction (i.e. viewing antibiotics and pesticides as environmental contaminants), while large conventional farmers tended to mention economic reasons, and smaller conventional farmers identified their usage of non-antibiotic treatments like topical udder creams and probiotic treatments.

Other dairy pathways: waste milk, manure, mortality

To be clear, the total life cycle of an antibiotic can go in many directions other than into food products. Historically, these other pathways are less frequently studied and more poorly understood. We found extremely variable perceptions amongst farmers when discussing transport of antibiotic residue into waste milk, manure, and through mortality or carcass disposal, none of which have industry wide regulations.

The practice of feeding waste milk to calves and heifers is widespread across the industry. However, concern about transport of antibiotics with this milk is less consistent between farmers. Though we found variable perceptions and practices around feeding waste milk, there were no discernable differences between farm sizes or farmer ages, with high and low levels of concern present in each category. Some farmers explained nuanced approaches to feeding waste milk, recognizing that waste milk *"does have some [antibiotic] residue in it. So you can't use that milk for calves that we plan on selling".* Other farmers have explained *"I'm not concerned about the level of antibiotics that would be in the waste milk, because we dilute that anyways with untreated milk".* The process of feeding waste milk to other animals cycles undegraded antibiotic residues back into livestock, which can be a cause for concern further down the line.

Some waste milk from antibiotic treated cows is disposed of with manure, rather than fed to animals, which pushes these residues to the transport pathway shared with manure. Some manure management systems reduce antibiotic residues and antibiotic resistant bacteria (e.g. high heat systems like aerobic composting, high temperature digestion, and bedding recovery units) while other systems transport these contaminants, unchanged, with manure (e.g. daily spreading). In our study, farmers were less likely to consider this transport pathway. Of those that did, organic farmers were more likely to consider this potential outlet, explaining *"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 about all the microscopic activity of a handful of soil",* suggesting that manure with antibiotic residues may negatively interact with soil microbiota. Some conventional farmers explained their lower levels of concern by their usage rates*: "I don't use much…if we had tons of cows on it, I would be worried"*. None of the farmers we spoke with managed their manure specifically to reduce antibiotic residue and resistant bacteria transport.

Perhaps most interesting, none of the farmers we spoke with identified animal mortality and carcass disposal as a possible pathway of antibiotic residue into the environment. On dairy farms, farmers often reduce on-farm mortality by culling cows and selling them for beef rather than treating them multiple times with antibiotics. It is therefore possible that this reduction of on-farm mortality reduced attention to the topic. Some research has shown that the high temperatures achieved in mortality composting, when carried out effectively, has been shown to reduce residue and resistant bacteria concentrations.

There are many decisions that farmers take that can lead to reduced loading of antibiotics into the environment. Those decisions, though generally made to further another goal, lead to the reduction of antibiotics in the environment at each step of the dairy farm process. From cow and calf nutrition, comfort, and health to non-antibiotic treatments, bacteria testing, and waste management systems, incremental decisions contribute to reduced environmental antibiotic loadings. Other articles in this series delve into these topics and the nuances our interviews revealed.

Antibiotic residue sources: Anthropogenetic & Agricultural

It is important to highlight that dairy agriculture is not the only user of antibiotics nor contributor to antimicrobial resistance (AMR). Across conventionally managed agriculture, antibiotics are used to varying degrees, and even occasionally on organic farms. Human antibiotic usage also contributes to environmental antibiotic loads through discharge of our waste water treatment systems. Some wastewater sources, such as hospitals, contribute more concentrated streams, while others, such as individual septic systems, likely contribute far lower concentrations. However, tackling the growing threat of AMR requires actions taken from all contributors, rather than associating blame for environmental contamination on one sector over another. The rising global threat of antimicrobial resistance is a result of combined global antibiotic usage, across both agriculture and human applications. Understanding animal ag's evolving usage of antibiotics and working to inform both the ag and non-ag industry on this

usage are good initial steps. Management decisions made by dairy farmers and animal ag can contribute positively to this effort, both locally and on a greater scale.