

SHORT COMMUNICATION

Antibiotic usage in 2013 on a dairy CAFO in NY State, USA

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Antimicrobial resistance is threatening humans and animals worldwide. Biosecurity and 1-year usage of antibiotics on a dairy concentrated animal feeding operation (CAFO) in NY State, USA, were mapped: how much antibiotics were used, for what purpose, and whether any decrease could be warranted. Approximately 493 kg antibiotics was used, of which 376 kg was ionophores (monensin and lasalocides), 79 kg penicillin, 16.5 kg lincosamides, 8.0 kg aminoglycosides, 7.7 kg sulfamides, 3.4 kg cephalosporin, 2 kg macrolides, 0.7 kg amphenicols, and 0.1 kg fluoroquinolones. Usage reduction by 84% was realistic without compromising the animal welfare. Further reduction could be possible by improving the biosecurity and by utilizing antibiotic sensitivity testing.

Keywords: *antibiotic usage; dairy CAFO; biosecurity; ionophores; mastitis*

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It is estimated that every year 23,000 people die and 2 million people get sick from infections caused by antibiotic-resistant microbes in the USA (1). The world is approaching the post-antibiotic era, and to slow down progression, antibiotic stewardship as well as prevention strategies are necessary (1). In the yearly global risk report by the World Economic Forum 2013, antibiotic-resistant bacteria were identified as one of the top global societal risks facing mankind (2). The single most important factor in developing antibiotic resistance is usage; the more antibiotics are used, the more resistance inevitably develops. There is also a clear link between antibiotic use on the farm, antibiotic resistance, and human antibiotic treatment failure (1, 3).

In 2010, the US Department of Agriculture (USDA) started to require antibiotic manufacturers to report their sales in the USA (4), while in Sweden, by comparison, information has been collected since the 1980s (5). Very little data exist on how much antimicrobials are used on actual farms in the USA. Without detailed information of antimicrobial usage in agriculture, measurements to curtail the usage are unfeasible.

The objective of this study was to map the actual usage of antibiotics on a dairy concentrated animal feeding operation (CAFO) in NY State during 2013. The intention was to evaluate how much antibiotics were used, for what purpose, and to establish whether any decrease in

antimicrobial usage could be warranted. Biosecurity was also investigated. The findings will be used for further studies in site-specific antibiotic resistance patterns, and the impact the antibiotic usage could have on the environment in connection to the CAFO.

Material and methods

The studied dairy CAFO milks 2,000+ and has close to a total of 4,000 animals, separated into two different locations. The milk production is approximately 12,000 kg per 305 day lactation. The dairy has expanded, with the herd size doubling several times during the last decade. A substantial number of new animals were introduced into the herd during the 10% herd expansion throughout 2013. The owner provided access to all the purchased receipts through 2013. The antibiotic purchases were cataloged in grams of active substance using Microsoft Excel and organized into different classes of antibiotics. The different feed rations were utilized to calculate the ionophore (monensin and lasalocides) usage. The milk testing results (the tests are performed four times per year) were used to approximate a possible decrease in dry cow treatment. The dairy management was interviewed with a biosecurity survey developed by Moore (6), consisting of 43 questions to evaluate the risks associated with biosecurity.

Results and discussion

In 2013, the dairy used approximately 493 kg antibiotics which were divided into: 376 kg ionophores (monensin and lasalocides), 79 kg penicillin, 16.5 kg lincosamide, 8 kg aminoglycosides, 7.7 kg sulfamides, 3.4 kg cephalosporin, 2 kg macrolides, 0.7 kg amphenicols, and 0.1 kg fluoroquinolones (Table 1).

All consumed antibiotics with the exception of the ionophores are classified according to WHO (3) as very important or critically important to human medicine. The cephalosporin usage at the dairy CAFO was 3.4 kg, in stark contrast to the entire Swedish cattle (0.5 million heads) usage of 7.0 kg in 2012 (5). In Sweden, cephalosporins are only permitted for animal use when all other treatment options have been exhausted and cephalosporins are tested effective (5). In the USA, a new 2012 directive restricts the use of cephalosporin drugs outside of approved use, in so-called extra label use (7). Swedish cattle used a total 4.02 kg of macrolides and lincosamides in 2012, while the dairy CAFO used 18.5 kg in 2013. While the farm does fairly extensive pathogen testing, very little or no testing is done to ensure correct effective antibiotic usage, which is reflected in the variation in antibiotics used for bovine respiratory disease (BRD). The management's perception is that this type of testing does not exist or that it lacks the timelines required for effective treatment.

Most of the antibiotics (excluding ionophores), 73.8 kg, were used by the milking cows: 24.6 kg by calves and 19 kg by heifers. The most common bacterial diseases on this dairy are mastitis and BRD; both multifactorial and often multi-bacterial (8), making diagnosis and treatment difficult. Other common disorders are general infections

and hoof disorders, while others are metabolic such as metritis, ketosis, and calf diarrhea. The route of administration can be summarized as 78% oral, 11% injectable, 10% intramammary, and 1% topical.

All animals are fed ionophores because they improve the milk production efficiency without compromising the body condition of the cows (9), while ionophores can treat ketosis (10). The US authorities have decided to phase out antibiotics feed as growth promotion; unfortunately, it only includes antibiotics deemed important today to human medicine (11). In comparison, antimicrobial usage on growth promotion was banned in 1986 in Sweden (5). Ionophores, while not used at present in human medicine, are showing some promise of becoming a cancer therapy (12). The US Food and Drug Administration (FDA) is investigating the possible link between ionophore-resistant and simultaneously acid-resistant *Escherichia coli* with the potential of serious human illness (13). To decrease the antimicrobial usage today, all antibiotics used as a feed additive could be excluded, which would result in a 76% reduction. The next area where antibiotic usage could decline today is in mastitis treatment.

All lactating cows were given dry treatment at the end of the lactation per recommended praxis in the USA (14). However, selective dry cow treatment could be utilized without endangering animal welfare or production (15, 16). On average, 71% of the lactating cows displayed somatic cell counts (SCC), measured by milk testing, of less than 142,000 SCC. For this study, we assumed that a 25% probability of all cows with a tested SCC < 142,000 are having a mastitis at dry off, based on udder health classes used in Sweden (17). The cows (29%) with an SCC > 142,000 are automatically given dry cow treatment. Cows with

Table 1. Antibiotic use at a large dairy in NY State, USA

Class of antimicrobials	Amount (kg) used for			Used as	Treating	Importance to human medicine (3)
	Cows	Heifers	Calves			
Cephalosporin	3.4	0	0	Treatment 96% prophylactic 4%	BRD, metritis, dry cow treatment	Highly important 8% Critically important 91%
Penicillin	61	18	0	Treatment 79% prophylactic 21%	Dry cow treatment, local infections, mastitis	Critically important 100%
Ionophores	268	78	30	Feed efficiency 100%	Coccidiosis, ketosis	At the present not used in human medicine
Lincosamide	1.1	0	15.3	Treatment 22% prophylactic 78%	Mastitis, BRD, feet infections	Highly important 100%
Amphenicols	0	0	0.7	Treatment 100%	BRD	Highly important 100%
Macrolides	0.3	1	0.8	Treatment 100%	BRD, foot rot	Critically important 100%
Fluoroquinolones	0	0	0.1	Treatment 100%	BRD	Critically important 100%
Sulfamides	0	0	7.7	Treatment 100%	Calf diarrhea	Highly important 100%
Aminoglycosides	8	0	0	Treatment 67% prophylactic 33%	Dry cow treatment, feet	Critically important 100%
Total used (kg)	341.8	97	54.6	All antibiotics	493.4	

an SCC < 142,000 at the time of dry off are tested for SCC with a 'cow side' test, using a testing method and device (18) suitable for the individual farm's preferences. With our assumption of 25% infections, 25% of these cows with SCC < 142,000 still need to be dry cow treated. Using selective dry cow treatment could, with our assumption and this dairy CAFO's average SCC, lead to a 47% reduction in antibiotic usage due to dry cow treatment.

During 2013, the herd had a calf respiratory outbreak of *Mycoplasma bovis*, and a limited prophylactic group treatment of lincosamide was administered. Excluding the use of ionophore, using selective dry cow treatment and no prophylactic use of antimicrobials could, in theory, have decreased the antibiotic usage in 2013 from 493 to 81 kg, a decrease of 84% without compromising animal welfare.

In Sweden, there has been a steady decline in antibiotic use in farm animals since the 1980s, showing that a decrease in the use of antibiotics is realistic with the right guidelines and rules (5). The antibiotic usage in the present US dairy should be initiated with antibiotic sensitivity testing, starting all treatment with narrow-spectrum antibiotics and only using broad-spectrum antibiotics, when proven effective and the narrow-spectrum antibiotics fail. In an outbreak, sensitivity testing should be repeated at least every 6 months.

One of the best options to decrease antibiotic usage is to prevent the infection in the first place with improved biosecurity (1). The biosecurity survey raised questions in the area of cattle purchases and livestock movement, reducing transmission onto the farm and within the farm (6). Certain disease testing was done before animal purchase; however, quarantine is never utilized when the animals enter the farm. Very few hygiene routines are in place to minimize the risk of transmission of microbes onto the farm, such as visitors and farm employees wearing clean clothing, coveralls, and clean footwear.

The calving pen and barn are only used for calving and calves are separated from the dam and fed single-source, high-quality, tested colostrums in a timely manner. The dairy CAFO has excellent pest management and milking hygiene practices, but quarantine of sick animals is not utilized. Sick milking cows are only moved from their designated group if they are too sick to function properly or if they need antibiotic treatment, while the heifers and calves almost always stay in the herd. Improvements in biosecurity would require a renewal of management strategies.

In conclusion, approximately 493 kg of antibiotics was used in 2013 at the dairy CAFO. Antibiotic usage reduction by 84% was found realistic without compromising the animal welfare. With improvements in biosecurity and antibiotic sensitivity testing to ensure appropriate and effective usage, the antimicrobial use could decrease even further.

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