DAIRY VETERINARY NEWSLETTER

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Empty Antimicrobial Drug Containers Compared with Treatment Records - How Much do they Differ on Dairy Farms?

A paper by D. Nobrega et al. in the December 2017 issue of J Dairy Sci examined an interesting question. I was at a Pan American Dairy Congress 20 years ago when someone who is now long retired said they had found that waste containers on dairy farms often told a different story regarding treatments used, teat end disinfection practices, etc. than what people said or what was written in records. I have observed this a few times myself. The paper compared treatment records with empty drug containers to measure antimicrobial use on dairy farms across Canada.

The study began by monitoring 89 dairy farms from many provinces in Canada. "Herds were specifically selected to represent Canadian milk-recorded herds." This included the proportion of freestall vs. tiestall housing and 12 month geometric mean bulk tank SCC classified as low (<150,000/ml), intermediate (150,000 to 300,000/ml), or high (>300,000/ml). Apparently there were no other criteria for representing Canadian herds such as milk production, herd size, etc.; at any rate none were described. Study herds all had some other characteristics which I suspect were required for enrollment, but were not stated as such: at least 80% Holstein-Friesian cows, milked 2X and "and participated in a DHI recording system." There were 38 farms not continued in the study: 10 did not record any antimicrobial treatments and/or did not and place any empty drug containers in waste receptacles, and 28 had at least 10% of treatment records "with missing data [from] the general health event form (GHEF) minimum required fields (cow ID, reason for treatment, treatment date, treatment product, and treatment duration)." I was impressed that 51 of the 89 farms actually had no missing data points in at least 90% of their treatment records; those 51 farms were the final study population "for approximately 2 yr."

Waste receptacles were placed in treatment areas on the farms as part of the project. "Farm personnel were instructed to dispose of all empty drug containers in these receptacles. Technicians and students visited all farms at least once per month. The number of empty drug containers was counted, and information regarding herd, antimicrobial used, product name and weight or volume, and start and end date of the current collection period was recorded." This is quite a lot of farms to visit, and I understand why the visits were not as frequent as weekly, for example. However, it seems to me that if other empty drug containers were discarded elsewhere or maybe someone emptied these containers in between visits, there might have been even more drugs used than were captured by the project. The results were interesting as is, however.

There appeared to be 3 main objectives of the study:

- Comparison of the volume of antimicrobials used according to treatment records vs. volume of empty drug containers on dairy farms
- Measuring the doses and the percentages of each type of antimicrobial used in dairy animals

- Measuring the doses and the percentages of each category of disease for which antimicrobials were used in dairy animals

The researchers did something which I think was very ambitious and difficult; they attempted to calculate the expected animal defined-daily dose (ADD in grams/day) for each drug. This was based on the label dose. For those cases with treatment records, each recorded day of treatment for each animal added one ADD. The actual ml, etc. of treatment volume was missing in > 90% of records, thus "all treatments were assumed to be rendered at the recommended daily dosage for that particular drug/disease combination." This is certainly unlikely; many treatments are used at a higher dosage than labeled. However, because few actual volumes were recorded, and considering that the authors wanted to use the standard measure of ADD, this makes sense and there was no alternative. It seems that when indeed a greater volume than label dose was actually recorded, there was no adjustment for that. Again, in order to use the standard measure of ADD, calculating the ADD based only on days of treatment is logical. This study was not about volume of drugs used alone, it was about estimated daily doses used. When the actual days of treatment were not recorded (11% of treatment records did not record duration), an extrapolation was made based on the actual recorded days for the same condition on the same farm. I think that was a reasonable idea; if the farm consistently treated some condition for 5 days when the label said 3 days, it makes sense to assume that cases with records not specifying duration were treated for 5 days instead of estimating based on the label duration of 3 days.

Another calculation of ADD was from counting empty containers, based only on how many labeled daily doses were in each container. If either the label of a drug was "almost exclusively for young stock" or 95% of more of the records suggested that animals treated with a drug were less than 1 year old, the ADD were estimated based on the dosage for an animal weighing 200 kg (440 lb). For adult cows, a standard body weight estimate of 600 kg (1320 lb) was used to calculate the ADD in grams/day. Each day of treatment for each animal (based on the label's statement of duration and dose per container) contributed one ADD.

Participating farm characteristics

The study farms had means of 80 lactating cows and bulk tank SCC 223,000/ml. 24 (47%) had freestalls, 22 (43%) had tiestalls, and 5 (10%) had other unspecified housing.

Results

There were 31,840 ADD according to empty containers, compared with 14,487 ADD using treatment records, indicating that only 45% of treatments were recorded (Table 2). There was considerable variation in total ADD among herds, which would likely be affected by herd size, but no range of herd sizes was shown. However, the conversion to a rate, ADD/100 cows/yr (ADUR) ranged from 94.5 to 1480, a nearly 16-fold difference according to containers, and from 4.3 to 455, a difference of over 100-fold according to treatment records. Herds clearly varied greatly in antimicrobial use, but even more so in disease treatment recording. Penicillins and cephalosporins were the most common antimicrobials used, accounting for 70.1% (Table 2).

"Mastitis, reproductive conditions, and dry cow therapy were the most frequent reasons for using antimicrobial therapy", accounting for 70.1% (Table 3). The most common drugs used for these conditions were: mastitis, penicillin combinations (43%); reproductive disease, third-generation cephalosporins (40%); dry cow therapy, penicillin combinations (86%). The paper contains quite a bit of detailed information regarding the different drug classes used for the different diseases/conditions. It also details for the different drugs the most common diseases they were used for, even the less commonly used drugs.

Conclusions

The comparison of empty containers to records showed that 55% of treatments were not recorded at all, which has certainly been found for decades in many on-farm studies, including those I have participated in. A limitation of the study, very difficult to overcome, is that both the treatment record-based and the empty container-based ADD assumed that the label dose, and nearly always the label duration, were used. There were probably fewer days of

treatment, at a higher dose per day in many cases. However, for comparison between what treatment records and empty drug containers reveal, this was a valid study design. It is almost impossible to capture "the truth" about treatments that are simply not recorded in any permanent way after white boards, cell phone texts, etc. are gone after the withdrawal period ends. This study expended a lot of time and effort trying to capture reality of treatments.

Table 2. Overall and relative frequency (%) of antimicrobial defined-daily doses (ADD), herd average antimicrobial daily doses per year (ADDR), and herd average antimicrobial daily doses per 100 cow-years (ADUR) recorded using inventory of empty drug containers (INV) and treatment records (TR) according to the antimicrobial used for treatment (from Nobrega et al. 2017).

		ADD				ADDR		ADUR	
Antimicrobial	**Herds**	**TR**	**%**	**INV**	**%**	**TR**	**INV**	**TR**	**INV**
Penicillins	**50**	**3,908**	**27.0**	**7,053**	**22.2**	47.2	87.5	48.8	92.5
Penicillin combination	**49**	**2,651**	**18.3**	**5,892**	**18.5**	33.4	74.7	32.2	77.4
Third-generation cephalosporins	**48**	**3,093**	**21.4**	**7,188**	**22.6**	38.6	92.7	39.3	94.2
First-generation cephalosporins	**45**	**1,589**	**11.0**	**2,156**	**6.8**	21.3	29.3	25.6	35.8
Trimethoprim-sulfonamide	40	1,215	8.4	2,635	8.3	18.2	41.1	19.9	43.4
Tetracyclines	39	997	6.9	2,101	6.6	15.3	34.8	11.3	31.5
Lincosamides	32	802	5.5	1,981	6.2	15.1	38.2	10.9	37.7
Phenicols	26	121	0.8	870	2.7	2.7	21.0	2.6	21.2
Macrolides	25	90	0.6	1,713	5.4	2.1	41.0	2.8	32.2
Fluoroquinolones	3	16	0.1	100	0.3	3.7	30.3	3.9	29.5
Other combinations	2	5	0.0	0	0.0	1.5	0	1.5	0
Aminoglycosides	1	0	0.0	150	0.5	0	87.9	0	25.5
Overall	51	**14,487**	100	**31,840**	100	171.6	387.7	172.4	396.1

Table 3. Overall (N) and relative frequency (%) of antimicrobial defined-daily doses (ADD), herd-average antimicrobial daily doses per year (ADDR), and herd-average antimicrobial daily doses per 100 cow-years (ADUR) recorded using treatment records (TR) according to the reason for treatment (from Nobrega et al. 2017).

		ADD			
Treatment reason	**Herds**[1]	**N**	**%**	**ADDR**	**ADUR**
Mastitis	**50**	**6,111**	**42.2**	74.6	77.0
Foot disease	37	1,040	7.2	16.8	18.0
Reproductive conditions	**37**	**2,022**	**14.0**	32.9	27.0
Dry cow therapy	**31**	**2,018**	**13.9**	39.3	38.1
Displaced abomasum	28	482	3.3	10.6	11.3
Respiratory disease	16	463	3.2	17.1	15.4
Fever	15	205	1.4	8.1	10.0
Other	37	1,200	8.3	19.4	22.4
Unknown	20	941	6.5	27.7	28.0
Unclear	2	5	0.0	1.5	1.1

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The finding that some farms administered nearly 1500 daily doses per 100 cows/yr suggests at least 2 or 3 antimicrobial treatment regimens on average per cow per year, which is remarkable. I was also surprised by the 16-fold range in daily antimicrobial dosage rates per 100 cows between farms indicated by the empty containers. It would be very difficult and time consuming, but it would be interesting to compare actual milk sold among these farms. There would certainly be a lot more milk discarded on the high dosage rate farms.

The authors included considerable discussion of limitations of treatment records as a true estimate of drugs used. They also suggested "- - it is very likely that receptacles were reminders to record treatments - - ", thus speculating that without the receptacles, recording of treatments may have been even less complete. They also make a good point that "restriction on antimicrobial use in animals is being contemplated, as well as potential effects of such restrictions. Rigorous methodology is needed to accurately assess the overall quantity of antimicrobials used in livestock." To me, it seems unlikely that most dairy farms will install and use specific receptacles for empty drug containers and count them, but inventory based on actual dosages used would be a good way to evaluate the completeness of treatment records, which are the only way to maximize residue avoidance and accurately assess which cows have had excessive need for antimicrobial treatment in the herd. Even doing the above for one month might illuminate for clients the need for more accurate recording of treatment of cows and calves.

Please let us know your comments and suggestions for future topics. I can be reached at (435) 760-3731 (Cell), (435) 797-1899 M-Tues, (435) 797-7120 W-F or **David.Wilson@usu.edu**.

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