Survey on routines in udder health management and therapy of mastitis on German dairy farms

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Abstract

The objective of this study was to gain information on udder health management and the use of antimicrobials in mastitis in dairy cows. The role of veterinarians in udder health management on dairy farms in Germany was a further focal point of this study. A total of 499 completed survey forms were returned by participating farms from nine federal states. Questionnaires revealed that the largest proportion of farms (32.1 %) were visited by their veterinarian on a weekly basis. The farm veterinarian was named most frequently as consultant for udder health (91.6%), followed by bovine health services (33.1%), agricultural consultants (27.5%) and other dairy professionals (20.0%). Fifty-eight percent of respondents had concise knowledge of parameters from the monthly udder health report submitted by the German Dairy Herd Improvement (DHI) organizations. Respondents from large farms (>500 cows) showed a significantly larger familiarity with udder health report contents than small farms (<100 cows) ($p < 0.05$).

Clinical cases of mastitis were treated on all farms, although only 74.9% of participants reported immediate use of antimicrobials after diagnosis. Regular use of penicillin, other ß-lactam-antimicrobials, macrolids and lincomycin was reported by 356 participants (78.4 %) with 363 participants (80%) reporting additional or sole use of fluorchinolones or 3rd and 4th generation cephalosporines in mastitis therapy.

Our results show that the farm veterinarian plays an integral role in mastitis management on German farms. A heavier focus should be directed at utilizing available udder health data for development of preventive and treatment protocols.

Key words: survey, mastitis treatment, antimicrobials, udder health management

Introduction

Mastitis is endemic on dairy farms worldwide [1]. Mastitis and strategic dry cow treatment are the main reasons for application of antimicrobials in dairy cows [2, 3, 4]. Antimicrobial resistance, however, has been recognized as a top public health challenge. In Europe, regulatory frameworks for use of antimicrobials in animals were recently modified. The EU commission notice EU 2015/C 2999/04 stresses the importance of prevention of mastitis in order to reduce antimicrobial use. Preventive strategies include implementation of best agricultural practice, avoidance of blanket antibiotic dry cow treatment, and an increased use of diagnostics in cases of clinical mastitis to adapt mastitis therapy to detected pathogens (EU 2015/C 2999/04). Good agricultural practices such as teat dipping, wearing gloves while milking and using automatic cluster take offs are known to be associated with a lower herd somatic cell count [5].

The objective of this study was to generate data on management practices related to udder health on commercial dairy farms in Germany. Specifically, we addressed the importance of diagnostic procedures, the role of veterinarians in udder health management, and the type of treatment protocols in use for mastitis.

Material and Methods

A questionnaire was developed to address farm demographic data as well as management practices related to milking and treatment of mastitis. The questionnaire consisted of 28 multiple choice questions and three 5-point Likert scales. Questions 21 - 28 were aimed specifically at data collection regarding antimicrobial mastitis therapy, including specification of preferred active substances.

The questionnaire was distributed using several convenience samples. In December 2015, a hard copy of the questionnaire was mailed to prospective participants through 6 bovine health service organizations (Thüringer Tierseuchenkasse, Tierseuchenkasse Sachsen-Anhalt, Bayern, Baden Württemberg, Hessen, Mecklenburg-Vorpommern) as well as the German Association of Performance and Quality Assurance (Deutscher Verband für Leistungs-und Qualitätsprüfung e.V., Bonn, Germany) in a single shipment. Throughout the spring of 2016, the questionnaire was additionally handed out at a series of six continuing education events for farmers. The questionnaires were returned by mail or fax. Participation in the survey was voluntary and anonymous data processing was assured.

Statistical analyses were performed using IBM SPSS Statistics for Windows (V. 20.0, IBM Deutschland GmbH, Ehningen, Germany).

Means and corresponding standard deviation (SD) were calculated for continuous and ordinal variables and are reported as mean ± SD. Frequencies were computed for binary and categorical variables. Percentages were rounded to the first decimal place. Some original categories from the survey instrument were collapsed for analysis. Statistical significance was assumed at P≤ 0.05.

Results

A total of 530 questionnaires were returned, equaling an approximate response rate of 30%. After exclusion of questionnaires containing illegible pages, 499 questionnaires were included in the statistical analysis. The percentage of answered questions ranged from 58.9% to 100.0% (Table 1 – Table 3). The participating farms were located in Thuringia (33.5%), Saxony-Anhalt (19.2%), Mecklenburg Western Pomerania (16.6%), Lower-Saxony (13.6%), Northrhine-Westphalia (4.2%), Hesse (1.2%), Bavaria (7.2%), Baden-Württemberg (4.0%), Saxonia (0.4%).

General herd and udder health information:

The sample consisted of 471 conventional farms (94.4%) and 22 organic farms (4.4%). The population of considered questionnaires was 499. The questionnaires were filled out by farm owners (63.9%), herd managers (34.3%) and milking personnel (1.8%). The vast majority of farms utilized milking parlor facilities (87.5%), with only 12.5% of farms depending on automatic milking systems (Table 1). The average daily milk production was 29.6 l (SD 4.3 l, Minimum 10.2 l, Maximum: 39.4 l). The average bulk milk SCC was 211.7 x 103 /ml (Table 1). The percentage of new cows > 100,000 SCC in the last month was reported by 58.9% of the farms and was 18.7% on average (Table 1).

Table 1. Demographics of the farms and number of respondents per question

Parameter	Respondents (n)	Descriptive statistics
Location of the farm	499	16 Federal states
Function of the respondent	499	Owner/Manager: 63.9% Herdsman: 34.3%, Milker: 1.8%
Cows in milk	482	293.64 + 283.6*
Milkings per day	499	2x: 80.4% 3x: 7.1% Automated milking: 12.5%
Rolling herd average (305-d, kg)	473	29.6 + 4.3*
Bulk tank SCC of the last month	473	211.7 + 198.3*
Type of production	492	Conventional: 94.0% Organic: 4.4%
Percentage of new cows > 100,000 SCC in the last month	294	18.7 + 10.3*
Frequency of veterinarian farm visits	474	Daily: 10.8%, 2 times a week: 16.8%, once a week: 32.1%, once per month: 19.8%, never: 15.6%
Nominated consultants (udder health)	499	Veterinarian: 91.6%, Cattle health service 33.1%, Agricultural consultants 27.5%, Others: 20.0%

*mean and standard deviation

Table 2. Questions and statements of the questionnaire considering number of answers for each item and descriptive statistics (499 farms): Milking routines and mastitis diagnostics

	Question	% of answered questions N = 499[a]	Response categories/ Descriptive statistics
	Milking routines		
10	How many employees milk on your farm?	100.0%	4,5 ± 3,6*
11	Are there written SOPs for milking on the farm?	100.0%	Yes: 25.9%
	Mastitis diagnostics		
12	When is a cow considered to have mastitis?	99.4%	Flakes in milk: 97.4%, Swollen quarter: 89.1%, High SCC: 64.7%, High CMT: 62.3%
13	Do you examine milk samples to detect mastitis pathogens?	100.0%	Yes: 70.5%
14	Which diagnostic methods are performed?	68.3%	Bacteriological examination: 87.2%, PCR: 8.8%, Assessment of SCC: 53.4%, Resistance test: 74.4%
15	What kind of milk samples do you consider for detection of mastitis pathogens?	70.5%	Clinical mastitis: 84.8%, High SCC: 58.3%, Calving 31.8%, Before dry off 17.2%
16	Who takes the milk samples for diagnostic testing?	70.5%	Veterinarian: 8.5%, Herdsmen: 36.4%, Milking personnel: 64.2%
17	When did you take the last milk samples?	Not analyzed	
18	When do you discuss the diagnostic results with your veterinarian?	70.5%	Discussion/yes: 94.8%, Routinely: 30.9%, In special cases: 88.6%
19	How often do you adapt your treatment protocols for mastitis accordingly to diagnostic findings?	64.5%	Routinely adapted, Yes: 86.0%, Ever: 28.2%, Never: 5.6%, Seldom: 52.8%, Monthly: 3.1%
20	Which pathogens are often detected in your milk samples (please specify 3 pathogens)?	58.9%	*Strep. uberis*: 11.0%, *S. aureus*: 10.8%, CNS: 9.9%, *E. coli*: 6.8%

*mean + standard deviation, [a]considering available number of respondents

The role of veterinarians in udder health management:

Routine veterinarian farm visits, though occurring on all farms, varied greatly in frequency. While 10.8% of farms reported daily veterinary visits, a bi-weekly (16.8%) or weekly (32.1%) schedule was far more common. 19.8% of farms reported monthly veterinary visits. Overall, 79.5% of veterinary visits were considered as routine. On 15.6% of the farms the veterinarian visited the farm only for emergency cases (Table 1). Consultations regarding udder health were sought from farm veterinarians (91.6%), bovine health services (33.1%), agricultural adviser (27.5%) and other professionals (20.0%) (Table 1).

Milking routines:

Participating farms had an average of 4.5 milking personnel, of which 70.8% had received formal training. Written standard operation procedures for milking routines were available in 25.9 % of the dairy farms.

Mastitis diagnostics:

Detection of changes in milk consistency (flakes, wateriness) was re-

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Table 3: Questions and statements of the questionnaire considering number of answers for each item and descriptive statistics (499 farms): mastitis therapy

	Question	% of answered questions N = 499[a]	Response categories/ Descriptives
21	Which clinical findings initiate a treatment of a cow with mastitis?	100.0%	A few flakes in milk: 51.5%, Lots of flakes in milk: 85.0%, Watery milk: 80.0%, High SCC 43.9%, Swollen quarter 85.6%, Positive CMT: 40.9%
22	When do you treat a cow with mastitis?	100.0%	Immediately: 74.9%, After consultation of farm manager: 25.5%, Consultation of veterinarian: 25.7%, Next milking period: 18.8%
23	Do you have written SOPs for mastitis treatment in your farm?	98.8%	Yes: 29.4%, No: 70.6%
24	Who decides in case of mastitis (single cow) which drug to use?	98.6%	Veterinarian: 56.9%, milker: 37.5%, Herdsman: 45.1%, Others: 5.6%
25	Who administers the drug?	99.0%	Veterinarian: 31.1 %, milker: 92.5%, Herdsman: 41.9%, Others: 4.5%
26	Please specify 3 antimicrobials, you often use in case of mastitis.	91.0%	Class 1: penicillin, other ß-lactam-antimicrobials, makrolide- antimicrobials and lincomycine: 78.4% class 2: fluorchinolones, 3rd and 4th generation cephalosporines: 80.0%
27	When do you finish the treatment of mastitis?	96.0%	After completing treatment protocol for mastitis: 57.7%, When flakes are not detected in milk: 51.9%, After using CMT: 23.0%, After interpreting a result of a microbial culture: 4.6%
28	When do you extend mastitis therapy?	100.0%	When flakes detected after therapy end: 78.6%, Quarter is still swollen: 51.0%, *Strep. uberis* was detected/ is important: 3.5%, Other pathogens are detected or are important: 7.9%
29a	I am content with the udder health situation of my dairy	99.0%	Fully agree: 6.0%, Agree: 42.9%, Neither agree nor disagree: 17.6%, Disagree: 30.3%, Fully disagree: 2.2%
29b	The therapeutic concepts of my veterinarian are efficacious.	97.4%	Fully agree: 9.8%, Agree: 65.9%, Neither agree nor disagree: 18.0%, Disagree: 3.0%, Fully disagree: 0.6%
29c	I`m content with the efficacy of pharmaceuticals.	99.0%	Fully agree: 7.2%, Agree: 63.1%, Neither agree nor disagree: 23.0%, Disagree: 5.0%, Fully disagree: 0.6%

[a]considering available number of respondents

garded as a diagnostic tool for mastitis by 483 farms (97.4%). Hardness and swelling of the udder, elevated SCC and a positive CMT were additionally used as diagnostic criteria in 442 (89.1%), 321 (64.7%) and 309 (62.3%) farms, respectively. Drawing milk samples for diagnosis of mastitis pathogens was common practice in udder health management in 352 (70.5%) of the dairy farms (Table 2). Bacteriological examination of milk samples was conducted most frequently, followed by quantification of SCC (53.4%) and PCR (8.8%). Reported indications for drawing milk samples included clinical mastitis (84.8%), high SCC (58.3%), immediately prior to dry off (17.2%) and before calving (31.8%) (Table 2). Milk sampling was conducted by milking personnel, herd managers and veterinarians on 226, 30 and 128 farms, respectively.

Bacteriological examination results were routinely discussed with the farm veterinarian on 94.8% of farms. Farmers discussed the results of bacterial examinations with their veterinarian on a regular basis (30.9%) or on special occasions (88.6%) (Table 2).

Specific mastitis treatment protocols were developed from bacteriological examination results on 86.0% of farms. Specification of frequently detected mastitis pathogens took place in 294 cases (83.5%) with *Strep. uberis* (11.0%), *S. aureus* (10.8%), CNS (9.9%) and *E. coli* (6.8%) setting the trend.

Treatment of mastitis:

Less than a third of respondents (29.4%) reported having a written SOP for mastitis therapy. All participating farms reported initiation of treatment after detection of clinical mastitis. Slightly flaky milk sufficed to initiate mastitis treatment on 51.5% of farms, while 85.0% of farms-initiated treatment in response to a large amount of flakes in milk. Watery milk, high SCC, swollen udder and a positive CMT were reported as reasons to initiate treatment on 80.8%, 43.9%, 85.6% and 40.9% of farms. Mastitis treatment was started immediately after diagnosis in 74.9% of the farms. In 18.8% of the farms, treatment was performed at the subsequent milking (Table 3).

The decision to extend initial antimicrobial treatment was based on persistent flakes in milk (78.6%), persistent udder swelling (51.0%), detection of *Strep. uberis* (3.5%) and detection of other pathogens (7.9%). The reduction of flakes in milk led to treatment termination in 57.7% of cases.

While 56.9% of farms involved the farm veterinarian in decisions regarding use of antimicrobials and choice of active substance, administration of medication was conducted primarily by farm personnel (92.5%). Veterinarians personally administered mastitis treatment on only 31.1% of farms. Respondents were invited to specify three antimicrobial drugs that they regularly used for mastitis therapy. The question was answered by 91% of participants, with 9% of respondents choosing not to answer. Class 1 antimicrobial substances (penicillin, other ß-lactam-antimicrobials, macrolide antimicrobials and lincomycin) were mentioned a total of 356 times (78.4%) and class 2 antimicrobials (fluorchinolones, 3rd and 4th generation cephalosporins) were mentioned a total of 363 times (80.0%).

Our data are unable to illustrate whether or not the degree of clinical mastitis affected the use of antimicrobials on participating farms. Data concerning exact quantities of antimicrobials used on participating farms was not extracted in this study.

Farmers' attitudes towards udder health, mastitis treatment protocol and veterinary advice:

Nearly half of the respondents (48.9%) were satisfied (i.e., fully agree and agree) with the udder health status on their farm. Satisfaction regarding treatment concepts prepared by veterinarians was high in 75.7% of cases (i.e., fully agree and agree) and the efficacy of used drugs was considered as good in 70.3% of cases (i.e., fully agree and agree).

Discussion

General herd and udder health information:

Analyzing udder health data from a given farm and setting achievable goals are important parts of a farm specific udder health program [6, 7]. 2015 marked the beginning of uniform udder health reports with benchmarking features by DHI organizations for German dairy farms (http://www.milchqplus.de/home_gb.html). In order to acquire an understanding of farmers' awareness of udder health report parameters, participants were asked to indicate the percentage of new cows > 100,000 SCC in the last month. We were able to show a significant divide in familiarity with udder health report data with 66.1% of participants from large farms (>100 cows) showing knowledge of specific parameters as opposed to only 43.4% of participants from small farms (<100 cows).

The average percentage of new cows > 100.000 SCC in the last month based on 294 respondents was 18.7% (SD 10%). This was similar to the annual average new intramammary infection rate of 19.8% reported for 4 million lactations in Germany in 2015 [7].

The role of veterinarians and consultants in udder health management:

McDougall et al. (2017) described veterinary advice as the single most important factor influencing decision making regarding antimicrobial use on dairy farms in New Zealand [9]. Jansen et al. (2009) reported similar results in the Netherlands, with farmers describing the veterinarian as the first person to contact in case of udder health problems [8].

In line with these findings, our study showed that the veterinarian was considered an important consultant regarding udder health on 91.6% of participating dairy farms. Routine veterinary visits were common in 79.5% of cases.

Milking routines:

The ultimate goal behind written SOPs is to increase consistency of work processes and, in turn, product quality [10]. While the majority of milking personnel in our study had completed some sort of formal training, written SOPs were only available on 25.9% of participating dairy farms.

Mastitis diagnostics and treatment:

Given findings from recent literature, mastitis treatment should be primarily based on identification of the causative pathogen. Clinical symptoms and individual risk factors should nonetheless be considered when deciding on an antimicrobial substance [16]. In order to implement a pathogen-based antimicrobial mastitis treatment protocol, Vasquez et al. (2017) recommend milk sample collection from all lactating cows with symptoms of clinical mastitis [11]. Our study shows that the majority of participating farms (84.8%) reported routine milk sampling from cows with clinical mastitis.

It is common knowledge that flakes in milk indicate a high probability of an infection of the mammary gland by a pathogen and similarly udder swelling is indicative of an inflammatory process [17, 20]. Criteria used to diagnose clinical mastitis by participating farms in our study largely corresponded with recommendations by the International Dairy Federation (IDF) with flakes in milk and udder swelling being used by 97.4% and 89.1% of farms, respectively.

In 70.5% of cases, milk samples subsequently underwent bacteriological examination. Bacteriological culture (87.2%) and sensitivity testing (74.4%) comprised the majority of testing methods, with PCR-based pathogen diagnostics playing a significantly smaller role (8.8%).

A survey conducted by Gibbons et al. (2013) in Ireland revealed that 95.7% of respondents (n=117) heeded the farm veterinarian's advice concerning active substances when making treatment decisions (citation). Similarly, in our study, results from bacteriological examinations were regularly discussed with the farm veterinarian in 94.8% of cases. In 86.0% of cases, bacteriological examination results were further used to develop treatment protocols for mastitis. However, detection of clinical symptoms such as moderate to considerable amounts of flakes in milk sufficed to initiate antimicrobial treatment in 51.5% and 85.0% of farms, respectively.

Bacteriological culture also plays an important role in selective dry cow therapy, enabling the differentiation between cows that would benefit from antimicrobial treatment and cows that would not [12]. However, selective dry cow therapy is not common in Germany thus far [14]. A frequently used alternative is basing dry cow treatment on SCC scores in monthly DLQ reports [13]. In accordance with these findings, only 17.2% of participating farms in our study conducted routine milk sampling before dry off. We can therefore assume that a large amount of farms relies heavily on SCC data for decisions regarding antimicrobial treatment.

A study conducted by DeBriyne et al. (2014) showed that fluorchinolones or cephalosporins of 3rd and 4th generation were used in 22% of mastitis cases Europe-wide [19]. Interestingly, these highest priority critically important drugs were used for mastitis treatment on 363 (80%) participating farms in our study.

Farmers' attitudes towards udder health on the farm, mastitis treatment protocol and veterinary advice:

Udder health status, efficacy of mastitis treatment protocols and efficacy of administered antimicrobials were rated positively by respondents overall. This is in accordance with a previous survey conducted in the Netherlands, which showed that dairy farmers evaluated the mastitis situation on their farms as being under control on a 5-point scale [8].

Conclusion

Our data indicate strengths and weaknesses of udder health management on German dairy farms. While we have seen an increase in available udder health data in recent years, written standard operating procedures for milking and mastitis treatment protocols are still only available on a small percentage of German dairy farms. Farm veterinarians continue to play an important role in udder health management and mastitis treatment. We can therefore conclude that a heavier focus should be directed at utilizing available udder health data for development of customized preventive and treatment protocols. Moreover, advocacy for use of written standard operating procedures should lie in the hands of udder health consultants and could significantly impact milking and treatment procedures on German dairy farms.

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