A Survey of Mastitis Detection Practices and Treatments on Dairy Farms in Bavaria, Southern Germany

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Abstract

The objective of this study was to quantify the approaches of Bavarian dairy farmers towards mastitis diagnostics and implemented treatment options. Between fall 2017 and spring 2018, a stratified random sample of Bavarian dairy farmers (shipping >200kg milk) was contacted to participate in this anonymous survey. In the end 156 dairy farmers participated. Mastitis severity scores (1-3) were used on 74 % of farms. However, regular laboratory mastitis diagnostics were done on only 44 % of farms. Therapeutic approaches depended on the severity of the mastitis cases. Farmers reported to treat mild cases with non-antibiotic treatments, e.g. homeopathy, themselves, they would call the veterinarian for more severe cases. Farmers reported that mild cases were treated with non-antibiotic treatments, e.g. homeopathy, or intramammary antibiotics. They were more likely to call the veterinarian for more severe cases. Few farmers reported to have regular discussions with their herd veterinarian about the reduction of antibiotic usage on their farms. In conclusion, the herd veterinarians should use their role as primary advisor to farmers to push for more diagnostics to enable more specific prevention and treatment strategies on Bavarian dairy farms.

Keywords: Survey, Dairy, Antibiotics

Introduction

Mastitis is one of the most common diseases on dairy farms. The majority of mastitis cases are due to infections with bacteria [1]. In Germany, approximately half of all antimicrobial doses used in dairy cows were attributed to intramammary treatments [2]. In particular antibiotic blanket dry cow therapy had been promoted as integral part of udder health programs for dairy farms over past decades [3]. Accordingly, most producers and veterinarians adopted the use of a blanket dry cow therapy [4, 5]. However, with improved udder health, easier access to udder health data, fewer contagious mastitis (e.g., with *Streptococcus agalactiae*) and proportionally more environmental mastitis infections [6], the need for a blanket dry cow treatment has been greatly diminished. Furthermore, in an attempt to further prevent the spread of antimicrobial resistances, the public pressure has increased to minimize the use of antibiotic therapies in human and veterinary medicine. As a result, the focus has shifted towards a more prudent drug use. For instance, mild mastitis cases with "no-growth" or gram-negative pathogens rarely benefit from (intramammary) antibiotic therapies. Withholding antibiotic treatment in these cases would reduce antibiotic usage by approximately a third - without negatively impacting cure rates, i.e. animal health [7, 8]. Therefore, the selection of antimicrobial therapies should be based on diagnostic test results [9]. In addition to treatment decisions on individual cases, control measures against mastitis need to focus on the daily implementation of preventive management practices on the farm [10]. Herd veterinarians should monitor the prevalence of mastitis pathogens and ideally use this information to support their dairy clients by creating both preventive (e.g. optimization of the milking routine) [6] as well as evidence-based diagnostic and treatment protocols for sick animals [10]. In order to achieve this, the consulting veterinarians need to know the mastitis pathogens of a farm but they also have to be mindful of the knowledge, needs, and motivations of the dairy farmer clients regarding management changes [11, 12, 13]. If the consulting practitioner does not target the level of knowledge or motivation of the farmer – either aiming too low or too high – a chance for a productive working relationship and the implementation of suggested best practices by the farmer may be jeopardized [14, 15]. At this point little is known about the approaches of Bavarian farmers towards mastitis diagnostics, selection of treatment options, dry cow therapy or treatment worthiness of cows. Therefore, the objective of this study was to quantify Bavarian dairy farmers' approaches towards mastitis diagnostics and implemented treatment options.

Materials and Methods

In the fall of 2017, a list of all dairy farms in the German Federal State of Bavaria (n=28,884) was used to generate a stratified random sample based on the amount of milk shipped to the creamery per day. The available list only included the amount of milk shipped but not the number of milking cows per farm. Farms with less than 200kg milk/day were excluded (n=4,873) from the study population as they were

assumed to have less than 10 lactating cows. The list of remaining herds (n=24,011) were split into quartiles based on the amount of shipped milk. A random list of 200 farms per quartile was generated. The aim was to recruit herds across Bavaria with 40 herds per stratum (n=160). The lists were split based on address to distribute the work evenly across all Bavarian regions or 10 branches of the Bavarian Animal Health Services (TGD), respectively. The farmers were invited to participate in this study by telephone. The technicians called along the list (starting at the 1st name of the list) until enough participants were recruited for the study in their area. Besides this anonymous survey, the overall study gathered more data on udder health and milk quality on Bavarian farms. Briefly, participating farms were visited once by 1-2 TGD technicians (n=20) to collect further data on udder health and management practices.

The here presented survey (Supplement) had a total of 23 questions (open, closed, multiple answers possible), incl. sub-questions, that were asking about the herd's demographics (n=7), diagnostic approach (n=4), clinical assessment and treatment (n=10) as well as general topics (n=2). Some of the questions were based on another survey that had asked German veterinarians about their diagnostic and treatment approaches as well as their perception of farmers' knowledge of mastitis in 2017 [16]. The survey was pretested with 6 TGD employees (3 technicians and 3 bovine veterinarians) and on occasion slightly rephrased to improve clarity of questions. The collected data was analyzed with SAS 9.4 (SAS Institute, Cary, NY, USA). Descriptive summary statistics and two-way comparisons were used (i.e, PROC FREQ, PROC NPAR1WAY WILCOXON, PROC MEANS) to describe the answers per group. Missing answers were ignored in the analysis. Alpha was set at 0.5.

Results and Discussion

Demographics: Between October 2017 and April 2018, 156 herds were recruited to participate in this survey. Due to seasonal work on farms and changes in weather (i.e., summer), the recruitment ended by the end of April as all strata had about the same number of herds at that point. The overall response rate was 46 %. However, smaller herds were less likely to participate than larger herds (group 1: 35 %, group 2: 41 %, group 3: 49 %, group 4: 57 %). The average herd size was 48 ± 33 cows. This is slightly higher than the average Bavarian dairy and most likely due to the exclusion of small herds with less than 10 cows. However, due to the randomness of the enrollment list, the results should be representative of Bavarian herds with more than 10 cows. Most commonly herds housed their cattle purely in freestalls (43 %) or tiestalls (31 %) or gave them access to pasture (11 % freestall, 11 % tiestall). Accordingly, milking parlors (47 %) were the primary milking systems used in Bavaria, followed by pipeline (40 %) and automated milking systems (10 % AMS).

About two-thirds of herds (74 %) had exclusively Fleckvieh cattle, which is in agreement with other reports of the region [17]. The average bulk tank somatic cell counts were 157,013 ± 73,483 cells/ml. Bulk tank bacteria counts averaged at 19,948 ± 19,915 CFU/ml. However, it was impossible to calculate an average 305-d milk production/cow with the provided data, because the question was unclear and farmers reported different measures of "average milk production": shipped milk or daily, lactational or annual milk yield per cow. Almost half of the participating farmers (46 %) were older than 50 years, while 12 % were between 20-30 years, 15 % between 31-40 years, and 27 % between 41-50 years of age.

Udder Health Diagnostics: Most herds participated in the monthly milk recording system (89 %). Less than half of the respondents (44 %) submitted quarter milk samples for microbiological diagnostics on a regular basis (i.e., ≥ once/year). This is in accordance with a study by [18] that found that 53 % of farmers would not take quarter milk samples of mastitis cows for further diagnostics. If study respondents took milk samples, they mostly took them from acute mastitis cases (87 % of respondents), high somatic cell count cows (57 %) or prior to dry off (39 %). Whole herd testing (6 %), testing of fresh (6 %) or purchased cows (2 %) were rarely done. Collected samples were either shipped to a specialized milk quality laboratory (45 %) or the laboratory of the herd veterinarian (42 %). Very few herds used both diagnostic options (13 %) and even fewer herds used any on-farm diagnostic for the detection of mastitis pathogens (9 %). A survey with veterinarians [16] also found that only a few German veterinarians (15 %) used any on-farm diagnostics for mastitis pathogens. On-farm-culture has been strongly promoted in other countries (e.g., United States) [19]. However, its implementation is difficult for German dairy farms. Firstly, the German infectious disease law [20] limits who can legally grow potential zoonotic pathogens. Secondly, the small number of samples per farm and year would hamper most farmers from building sufficiently reliable diagnostic skills and make this investment therefore cost-prohibitive. Unfortunately, we cannot further elaborate on how the on-farm pathogen diagnostics were actually done on the farms of this study, as we did not further inquire about the specifics of tests used.

Three quarters (74 %) of study participants used the provided severity score of clinical mastitis. If they classified the severity, they most commonly used grade 1 (visually abnormal milk), grade 2 (abnormal milk & quarter), and grade 3 (abnormal milk & quarter with an overall sick cow, e.g., fever) [7, 21]. Two farmers stated that they used this severity score but just named it differently. Overall, this is a slightly higher proportion than veterinarians anticipated, because 69 % of veterinarians estimated that at least 50 % of their farmers would know this common mastitis scoring system [16]. Two additional farmers had a deviating scoring system, but only one farmer elaborated on his system. He used two categories: a) chronical and subclinical mastitis (cows with an SCC of ≥250,000 cells/ml with or without visually abnormal milk) and b) acute mastitis (abnormal milk and inflammation at quarter with or without a sick animal). The diversity in answers shows that veterinarians need to clearly communicate with their clients about disease definitions to allow a productive conversation about mastitis.

Mastitis Treatments: Based on the presentation of each mastitis case, the producers would decide whether to call a veterinarian or not. Producers were more likely to call a veterinarian at once for cows with mastitis grade 3 (80 %, n=121) and grade 2 (68 %, n=103) than just abnormal milk of grade 1 (30 %, n=20). Some respondents (13 %, n=14) waited for a few days (2.2 ± 1.3 days), if a cow showed abnormal milk, until they would call their herd veterinarian. Herd veterinarians were rarely asked (9 %) to assess or treat mastitic cows during routine herd visits.

Regardless of herd size (P>0.50), most farmers had neither a formal treatment protocol (59 %, n=89) nor knowledge of the names of the medication used for the treatment of mastitis (>59 %). Still the dairy producers principally knew how mastitis was treated and reported different treatments depended on the severity of the mastitis case. Mild cases were predominately treated with homeopathy (38 %), topical udder liniments by the farmers themselves (n=17) or antibiotic intramammary tubes (39 %) (Table 1). While the scope of the survey did not allow to identify which mastitis cases the farmers selected for antibiotic or homeopathic treatment, the findings are similar to results

of [18] who also found that farmers commonly used homeopathy – probably with or without the legally necessary veterinary prescription [18]. While some environmental infections have a high spontaneous cure rate [22], some cases of mild clinical mastitis would likely have benefited from an intramammary antibiotic therapy. The efficacy of homeopathy against mastitis unfortunately does not go beyond a placebo effect [18].

In contrast, severe cases were more likely treated with intramammary (71 %) and/or systemic antibiotics (48 %) or anti-inflammatory drugs (61 %, Table 1). Homeopathy was used by 8 % of farmers for grade 3 mastitis cases. The benefit of the anti-inflammatory drugs for supportive treatment of severe cases of mastitis is well established [23]. However, the efficacy of systemic antibiotics against mastitis cases depends on the pharmacodynamics of the antibiotics and the pathogen and may not be suitable for all pathogens [24]. As the more severe cases were predominately treated by the veterinarians, farmers were less sure which medication (i.e., "do not know") were used or why these were selected.

Table 1: Used treatment options mentioned by farmers for different severities of mastitis. Multiple answers possible

	Severity Score of Mastitis		
Medication	1 (%, n=141)	2 (%, n=149)	3 (%, n=147)
Antiphlogistics	8	26	61
Intramammary antibiotics	39	72	71
Homeopathy	38	16	8
Systemic antibiotics	1	10	48
Other	9	7	3
Do not know	9	13	17
Product name unknown	66	61	59

Dairy producers reported that they thought veterinarians selected mastitis treatments based on activity spectrum at antibiotic, withhold times and treatment interval (Table 2). The cost of the medication was rarely a selection criterion for farmers and/or veterinarians (n=9). Interestingly, farmers thought that their veterinarians preferred broad spectrum antibiotics for the treatment of mastitis, which is in agreement with statements by veterinarians [16]. This may be due to the fact that not all cows with mastitis were diagnostically assessed. Therefore, veterinarians simply chose a broad-spectrum antibiotic to cover gram-positive and gram-negative bacteria – even though most mastitis cases in Southern Germany are caused by gram-positive pathogens with in vitro sensitivity to Penicillin [6] and gram-negative mastitis does not benefit from antibiotic therapy [8]. However, not all cows were considered treatment worthy and farmers would refrain from treating mastitis cases with antibiotics. Most commonly farmers considered cows treatment unworthy, if cows had "relapses" in clinical mastitis cases after treatment (70 % of respondents), if cows had not clinically responded to therapy in the first place (60 % of respondents), if cows had frequently clinical mastitis (56 % of respondents), and in cows chronic high somatic cell counts (52 % of respondents), or a combination of these reasons. This assessment of farmers is validated by observations that cows with previous clinical mastitis had a lower likelihood of bacteriological cure after antibiotic treatment at a second case of clinical mastitis in the same lactation [8]. In addition, 52 % of respondents also included other diseases of the cow in their decision about the antibiotic treatment-worthiness of a cow with clinical mastitis. Infertility (76 %) and lameness (41 %) were most commonly considered in such cases. This is not surprising as cows with infertility, lameness or repeated cases of mastitis are economically costly due to higher treatment costs, including labor, and lower production [25, 26]. Therefore, those cows are subsequently more likely to be culled than healthy herd mates [25, 26] and farmers are probably less likely inclined to treat them for additional diseases.

It is further noteworthy, that farmers were not quite sure about the selection criteria of anti-inflammatory drugs as they also stated that the activity spectrum should preferably be broad (44 %) or narrow (11 %) for anti-inflammatory drugs (44 % unspecified). The superficial knowledge of farmers of selection criteria for different medications as well as the farmer's preference to use alternatives to antimicrobials (particularly for light cases of mastitis, esp. grade 1) could provide veterinarians with the opportunity to discuss best treatment options with their farmers and to enhance prudent antibiotic usage on farms. However, the best selection of antibiotic therapy can only be done by knowing the infection status in each case of mastitis [27]. This includes the early identification of mastitis pathogens in mild mastitis cases (grade 1 & 2) as they might be no medical emergency but could still require antibiotic therapies to increase the likelihood of a bacteriological cure [28].

Table 2: Selection criteria for medication of mastitis by veterinarians – according to farmers. Multiple answers possible

	Intramammary Antibiotics (%,n=147)	Antiphlogistica (%, n=143)	Systemic Antibiotics (%, n=144)
Withdrawal time	26	17	12
Activity spectrum	68	43	47
Activity duration	6	6	3
Price	6	0	0
Do not know	27	63	63
Frequency of application	24	-	-

Dry Cow Treatments: Fourteen herds (9 %) never used antibiotic dry cow therapy. Across all study herds, dry cow therapy was used, on average (median), for 50 % (Interquartile range: 20-100 %) of the lactating cows. While overall antibiotic dry cow therapy usage was lower than other reports from Germany [5, 29], the proportion of herds not using any antibiotic dry cow therapy was comparable to the 9.7 % of [5]. The majority of farmers (n=115, 81 %) responded about the dry cow antibiotic treatments used on their farms. The most commonly mentioned antibiotics were a combination of Framycetinsulfat, Benethamin-Penicillin and Penethamathydroiodid (Benestermycin, Boehringer-Ingelheim; 38 % respondents with dry cow treatments), Cloxacillin-Benzathin (Orbenin Extra, Zoetis; 24 %) or a Cefquinome (Virbactan, Virbac; 10 %). Farmers, who named Benestermycin, Orbenin Extra or a Cefquinome as their primary dry cow therapy, treated, on average, 71 ± 30 %, 62 ± 37 %, or 54 ± 36 % of their cows at dry off, respectively. However, it is unclear how many cows were actually treated with the respective dry cow therapy on each farm and how cows were selected to receive dry cow treatments – as some farms (n=13) named more than one dry cow product. Some farms (n=10) cited as primary cow therapy a 4th generation Cephalosporin (Cefquinome). Six of

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these farms did not mention any other antibiotic for dry cows and two farmers even reported to use it as blanket dry cow therapy. One of the latter two farmers had repeated talks with their herd veterinarian to reduce antibiotic usage while the other farmer stated to have never had a discussion with their veterinarian about decreasing the antibiotic usage on their farm. Overall, less than half of the respondents (41 %) had regular talks with their herd veterinarian about opportunities to reduce antibiotic usage and 19 % could not recall to have ever had that discussion with their herd veterinarian. Only 5 % of dairy producers thought that their herd veterinarian frequently talked about the reduction of antibiotic usage with them. This is in stark contrast to the responses of a different survey with veterinarians, where 67 % of veterinarians stated that they would talk about antibiotic reduction at least on a regular basis (59 %) or very frequently (8 %) [16]. One might speculate that the herd veterinarians were not aware of this miscommunication. Similar to other parts of the world [30], the herd veterinarian was the primary source for information about animal health for almost all respondents (98 %). The influence of the herd veterinarian on initial uptake of selective dry cow therapy must therefore not be underestimated. For instance, another recent Bavarian study showed [31] that the farmer needed the herd veterinarian's support to start implementing selective dry cow therapy on their farm - including how to do the sampling and application of internal teat sealants. If the herd veterinarian was not supportive, this hampered the long-term success of the participation in the selective dry cow therapy program. However, antibiotic usage is not solely dependent on the veterinarian. A farmer may be risk averse and therefore may prefer to stay with the current system of blanket dry cow therapy [32]. Then the veterinarian has to be concerned about losing a client and potential income [32], if they push too hard for a lower antibiotic usage. Furthermore, as farmers are increasingly interested in alternative treatment options, the veterinarians might want to provide more information about alternatives to antibiotic therapies. However, due to the lack of evidence-based options [33] veterinarians may be hesitant to use or recommend alternative therapies.

Conclusions

In summary, dairy farmers were aware of different severity scores of mastitis and report to assess the antibiotic treatment worthiness of mastitis cases. Even though they only have a basic understanding of selected medication, the lack of in-depth knowledge about medication provides veterinarians with the opportunity to reduce the antibiotic usage for the treatment of mastitis on their clients' farms. However, veterinarians also need to stress the importance of microbiological diagnostics so that antibiotics can be selected appropriately and their prudent usage further promoted.

Disclosure of Conflicts of Interest

The study was made possible with financial support of the Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten and the Bayerische Tierseuchenkasse as well as MSD Tiergesundheit. The authors declare no conflict of interest.

Compliance with Ethical Standards

The survey was anonymous and conducted in compliance with ethical standards.

Annex 2020/5 Questionaire (Language German)

The supplement with questionaire is availiable as separate document. https://openjournals.hs-hannover.de/milkscience/article/view/130

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