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THE DEVELOPMENT OF DAIRY FARM LEVEL MULTI-ACTOR TEAMS TARGETING REDUCED ANTIBIOTIC USE IN ROMANIA

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Abstract

The Multi-actor Farm Health Teams (MAFHT) developed for dairy farms are teams that include farmers, veterinarians, and advisors covering complementary areas of interest in the field. The main objective of MAFHT is the design of the Multi-Actor Farm Health Plan (MAFHP) of actions by using the DISARM model. This model uses a participatory, farmer-led approach that was used previously in Denmark and the UK. This paper aimed to describe the particularities of MAFHP's in five Romanian dairy farms designed to improve animal health and to reduce the need for antibiotic treatment. Farmers usually face management and/or health problems in correlation with the age category and physiological condition. The most common calf diseases were respiratory and enteric, but these problems did not create severe outbreaks of disease. Large dairy farms are more common with hoof disorders while small dairy farms are more exposed to udder diseases. All teams demonstrated their ability to identify farm practices to reduce bacterial disease and the need to use antibiotics.

Key words*: antibiotic resistance, livestock farming, best practices, innovation, precision farming.*

INTRODUCTION

In the context of reducing antimicrobial use (AMU) in food animal production, strategic objectives to optimise the use of antimicrobial medicines in human and animal health were developed in the global action plan of the World Health Organization (WHO, 2021), Also, the European Union (EU) approved new measures to fight antimicrobial resistance (AMR), mainly regulations on veterinary medicines and medicated feed (EU, 2019a; 2019b). These regulations provide an important foundation for the preservation of the antimicrobial's efficacy. To date, several EU Member States have been implemented a broad series of changes with substantial progress on AMR and AMU (More, 2020).

Moreover, AMR and AMU must not be the sole responsibility of the medical staff, and they should hold all actors directly or indirectly responsible for human and animal health. To increase the awareness and involvement of all actors involved in animal husbandry, several innovative approaches have been described. These innovative approaches are farmer-led (Morgans et al., 2021), based on the Danish stable schools (Vaars et al., 2007; Bennedsgaard et al., 2010), and/or focused on developing multi-actor groups of farmers and other stakeholders (see https://disarmproject.eu/what-we-do/farm-health-teams/).

In the participatory, farmer-led approach to changing practices around antimicrobial use, Morgans et al. (2021) promoted a novel

application in the context of reducing AMU on UK dairy farms by prioritizing and promoting farmer expertise in identifying and solving farm-specific challenges (Morgans et al., 2021).

The innovative "Danish stable" schools promote the development of the individual farmer and dairy production in a 1-yr process of study with a small group of farmers by using farmers' motivation and experience-based learning process: one farmer and farm are analysed and advised by the farmers' group in a cyclical process in which all farmers take both roles. Participating farmers must have a common goal, let others get information about their farm, create an agenda to direct as a host farmer, and be equal in the sense that all the experiences and opinions of one farmer are accepted by the other farmers. In this type of schools, Vaars et al. (2007) and Bennedsgaard et al. (2010) proved the ability of farmers to reduce the use of antimicrobials in their herds without negative effects on production and herd health or in phasing out antibiotics from organic dairy herds (Vaars et al., 2007; Bennedsgaard et al., 2010)

The interest in finding the best innovative solutions to reduce the need for antibiotics in animals was also manifested in Romania, where the involvement of farmers, veterinarians, and feed advisors in Disseminating Innovative Solutions for Antibiotic Resistance Management (DISARM) thematic network was remarkable (see: https://disarmproject.eu/).

In this context, the paper presents an analysis of the evolution of the Multi-actor Farm Health Teams (MAFHT) developed for dairy farms in Romania, and the design of the Multi-Actor Farm Health Plan (MAFHP) of actions by using the DISARM model. The paper highlights the particularities of MAFHP's in five Romanian dairy farms designed to improve animal health and to reduce the need for antibiotic treatment, activities carried out within the DSARM project.

MATERIALS AND METHODS

In order to characterize the evolution of the Multi-actor Farm Health Teams (MAFHT) developed for dairy farms in Romania, five Romanian dairy farms were chosen. In the selection of dairy farms, we were focused to identify heterogeneous herds sizes with different operating technologies.

Dairy Farms

Dairy Farm 1 (DF1) has been 27 adult cows, 1 calf, 6 heifers, and 15 calves. The key person in the management of the dairy farm is a young farm health manager and veterinary doctor with 11 years of experience in dairy farming. He is directly responsible for the health of the herd and manages all activities of surveillance and control of animal diseases. Also, he is responsible for implementing the best measures to manage the herd health.

Dairy Farm 2 (DF2) has been 1006 adult cows, 349 heifers, and over 750 calves. The key person in the management of the dairy farm has 40 years of experience in the field of dairy farming. The farm has its staff, including veterinarians and zootechnical engineers, but for some specific disease problems, the owner also hires external consultants (e.g., veterinarians and feed advisors).

Dairy Farm 3 (DF3) has been 678 adult cows, 125 heifers, and over 200 calves. The key person in the management of the dairy farm is a zootechnical engineer responsible for raising and animals' welfare. The farm has its staff, including veterinarians and zootechnical engineers, but for specific veterinary medical activities, the owner also hires external consultants (e.g., veterinarians and feed advisors).

Dairy Farm 4 (DF4) has been 720 adult cows, over 150 heifers, and over 600 calves. The key person in the management of the dairy farm is an entrepreneur with great experience in agriculture which developed in just 14 years one of the most modern dairy farms in the region. The dairy farm has its veterinarians and zootechnical engineers and sometimes requests advice on nutritional issues from international specialists. In this farm, the management of the herd health and breeding is done through veterinarians and zootechnical engineers under the direct coordination of the owner.

Dairy Farm 5 (DF5) has been 24 adult cows, 10 heifers, and 6 calves. The key person in the management of the dairy farm is a young

entrepreneur and veterinarian who began to develop a dairy farm with his family.

BioCheck scoring tool

All dairy farms were scored before the design of MAFHPs by using the biosecurity scoring system Biocheck.UGent™ to quantify biosecurity in cattle production. The scoring system consists of one questionnaire that contains 124 questions. The system provides various biosecurity scores and allows for benchmarking of farms and herd-specific advice for improvements (Damiaans et al., 2020).

MAFHT

The Multi-Actor Farm Health Teams brings together the owner or manager of the dairy farm and his veterinarian, who are supported by other health and feed specialists. Each team from the five dairy farms included in this analysis has a facilitator who organizes the team's activity, supports the team in drafting the action plan, and identifies specialists who can provide information specific to the health of dairy farms.

MAFHT is in charge to diagnose the dairy farms' main points of improvement that will increase the herd health status that can result in a reduced need for antibiotics and a lower potential for antibiotic resistance on the farm.

MAFHP

The Multi-Actor Farm Health action plan is based on the Planning-Do-Check-Adjust (PDCA) cycle. MAFHP is focused on (1) listing and determining goals and points of improvement, (2) SMART (Specific/ Measurable/Acceptable/Realistic/Time-specific) definition of each goal, (3) detailed description of the action plan to achieve each goal (each action of the plan is described, has a project owner and a project implementer, and clear deadlines for starting, running, and completing), (4) Monitoring execution of actions for each goal, and (5) adjusting action plan and/or goals.

RESULTS AND DISCUSSIONS

The analysis of farmer's profiles revealed that three farmers have long experience in raising dairy cows, one dairy farm health manager has over 11 years of experience and one dairy farm owner has only one year of experience. Farmers with experience in this sector of activity and who have large dairy farms, promote the concept of teamwork, and have veterinarians, zootechnical engineers, and agronomists employed within the company.

All farms expressed interest and responded positively in developing their productive performance by increasing or maintaining the health of dairy cows and reducing the need to use antibiotics. Moreover, large dairy farms had already implemented programs to monitor the use of antibiotics in lactating dairy cows. Testing of antibiotic residues in milk was already implemented as a common practice and part of the commercial relations with milk processing factories. One of the dairy farms has shown interest in developing the veal sector.

To improve the health of dairy cows, the MAFHTs of all five farms propose the introduction of measures to reduce bacterial infections and antibiotic use on dairy farms. To reduce the consumption of antibiotics, the dairy farms will identify risk factors of the bacterial disease's emergence that require the excessive use of antibiotics as the only solution for healing and animal welfare.

MAFHP of DF1

The BioCheck scoring tool revealed values around 50% in the subcategory "Purchase and reproduction" (47%) of the external biosecurity and the subcategories "Calving management" (43%) and "Dairy management" (53%) of the internal biosecurity (Figure 1). In the light of the biosecurity scoring, MAFHT provided advice on the management of cattle breeding and health on the dairy farm to avoid the unjustified use of antibiotics. Also, in this farm was identified the opportunity to organise a "Stable school" by using Vaarst et al. (2007) model.

The MAFHP of DF1 has the following goals: (1) Identification of factors that may promote the occurrence and spread of bacterial diseases; (2) Identification of solutions for optimizing animal husbandry management; (3) Identification of solutions for optimizing animal health management.

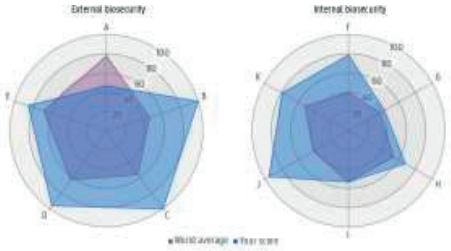

Figure 1. Subcategories scores of the internal and external biosecurity obtained by using the biosecurity scoring system Biocheck.UGent™ in DF1 (A. Purchase and reproduction; B. Transport and carcass removal; C. Feed and water; D. Visitors and farmworkers; E. Vermin control and other animals; F. Health management; G. Calving management; H. Calf management; I. Dairy management; J. Adult cattle management; K. Working organisation and equipment)

Identification of factors that may promote the occurrence and spread of bacterial diseases included four actions:

1. *Determination of possible non-compliance with biosecurity measures when people and vehicles access the dairy farm*. In addition to the biosecurity practices already implemented in the farm, the farm's biosecurity plan has been strengthened to minimize the risk of transmitting infectious diseases to employees and visitors. During the period monitored by MAFHT, the movement of visitors and staff employed on the dairy farm was substantially reduced due to restrictions on the movement of persons during the COVID-19 pandemic. The COVID-19 epidemiological context has significantly increased the responsibility of its staff and visitors to comply with existing biosecurity measures.
2. *Milking monitoring*. During the monitoring period it was found that the personnel involved in this activity comply with the hygienic and technological stages of milking. Also, the milking stages carried out by the staff involved in this activity were completed with steps to reduce the risk of transmitting infectious diseases to employees and visitors.
3. *Colostrum quality assessment*. Possible introduction of a colostrum quality analysis method using a refractometer.
4. *Establishing the role played by the respiratory complex of calves, enterocolitis in calves, pododermatitis, and mastitis in herd pathology*. This action should be adjusted to correlate bacterial infectious diseases with diseases of nutrition and metabolism.

Identification of solutions for optimizing animal husbandry management included three actions:

1. *Feed management optimization solutions*. Continuous evaluation of the feed management.
2. *Solutions for optimizing the management of shelter hygiene*. Continuous evaluation of the shelter hygiene management.
3. *Milking management optimization solutions*. Continuous evaluation of the milking management.

The farm health team has established that the activities of this objective must focus on obtaining information that answers the following questions:

- To what extent can some identified technological deficiencies be factors favouring bacterial diseases?
- How often can these deficiencies be present?
- Which people should be held accountable for remedying or preventing the occurrence of these deficiencies?
- Is it necessary to set a deadline for meeting these objectives or should they be applied continuously?
- What is the best way to monitor deficiencies in animal husbandry management?
- What target value is realistic and achievable and in what time frame?

Identification of solutions for optimizing animal health management included four actions:

1. *Solutions for optimizing the health management of lactating cows*. Continuous evaluation of the health management of lactating cows. To improve the health of dairy cows on the farm, the farm's health team proposes the introduction of measures to reduce the number of cows with milk fever and reduce the risk of injury that requires treatment with antibiotics. Milk fever management will involve investigating farm risk factors through stable analysis. Based on the number of cows with this manifestation, it will be decided at a later stage, if and when recommended to apply preventive

measures. To reduce the risk of accidents that require treatment with antibiotics, it will be necessary to identify the stable factors that favour the occurrence of these events.

2. *Solutions for optimizing the health management of cows during the dry period*. Continuous evaluation of the health management of cows during the dry period.
3. *Solutions for optimizing the health management of cows during the transition period (antepartum and postpartum)*. Continuous evaluation of the health management of cows during the transition period. The transition period can negatively influence the subsequent lactation, with implications on production and reproduction performance. The quality of the health management during the transition period is reflected in the frequency of postpartum disorders (e.g., milk fever, dysplasia of the abomasum, and placental retention).
4. *Solutions for optimizing and managing the health of calves and heifers*. Continuous evaluation of the health of calves and heifers.

MAFHP of DF2

The BioCheck scoring tool revealed values around 50% in the subcategory "Calving management" (26%) of the internal biosecurity. The MAFHT provided advice to improve the management of calving and calf in the specific MAFHP developed for DF2 (Figure 2).

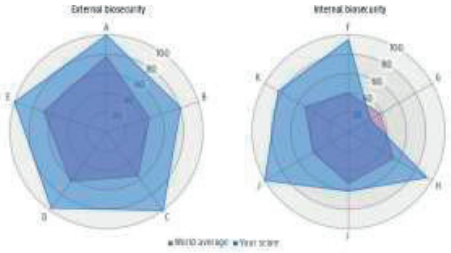

Figure 2. Subcategories scores of the internal and external biosecurity obtained by using the biosecurity scoring system Biocheck.UGent™ in DF2 (A. Purchase and reproduction; B. Transport and carcass removal; C. Feed and water; D. Visitors and farmworkers; E. Vermin control and other animals; F. Health management; G. Calving management; H. Calf management; I. Dairy management; J. Adult cattle management; K. Working organisation and equipment)

The MAFHP has the following activities:

1. *Analysis of the possible transmission of diseases through direct and indirect contact*. Calves will receive the feed on their own bucket that will be personalised with the number of the calve accommodation box. The hygienic measures will be applied after each feeding by cleaning the buckets and preventing the contamination of buckets with dust, insects, and dirty water. Calves will receive colostrum only from the farm's cows and those who have not been treated recently with antibiotics (Dewolf & Van Immerseel, 2019).
2. *Evaluation of the intake of maternal antibodies administered through colostrum in the first hours of life*. Enough colostrum (200 grams of IgG antibodies) should be administered within 6 hours of birth. Mother's colostrum from the first milking is preferred to that of other cows. Due to the low capacity of the abomasum, colostrum will be administered frequently in small quantity feedings. Colostrum will be refrigerated between feedings, bottles, and tubes for colostrum administration will be cleaned and disinfected after each use (Dewolf & Van Immerseel, 2019). The farm implemented a protocol for determining the serum protein in the blood at 72 hours after birth by using a refractometer.
3. *Assessment of calf housing conditions*. In accord with Dewolf & Van Immerseel (2019), MAFHT recommended that the calves will be housed in individual calf boxes or hutches in the first weeks of life and regrouped in pens of 7-10 calves of the same age. The spreading of urine and faeces between boxes or hutches must be avoided and the surfaces must be easily cleaned. The contact between different calf groups will be avoided.

MAFHP of DF3

The BioCheck scoring tool revealed values around 50% in the subcategory "Transport and carcass removal" (46%) of the external biosecurity and in the subcategories "Health management" (53%), "Calving management" (10%), and "Working organisation and equipment" (17%) of the internal biosecurity (Figure 3). The MAFHT of DF3 provided

advice to improve the internal and external biosecurity into the MAFHP.

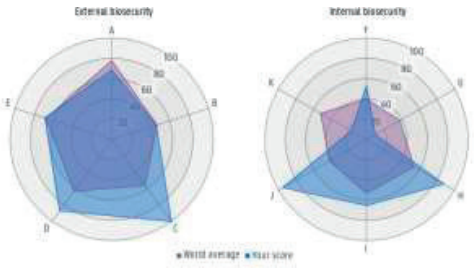

Figure 3. Subcategories scores of the internal and external biosecurity obtained by using the biosecurity scoring system Biocheck.UGent™ in DF3 (A. Purchase and reproduction; B. Transport and carcass removal; C. Feed and water; D. Visitors and farmworkers; E. Vermin control and other animals; F. Health management; G. Calving management; H. Calf management; I. Dairy management; J. Adult cattle management; K. Working organisation and equipment)

The goals of the MAFHP are (1) Identify issues that may affect calving and calf management, and (2) Identify deficiencies in work organization and equipment that may affect internal biosecurity.

The identification of the issues that may affect calving and calf management has brought together three activities:

1. *Analysis of the possible transmission of diseases through direct and indirect contact*. Each individual box will have its own bucket that will be cleaned and disinfected after each use. Colostrum from other farms will not be used. Colostrum should not be used in cows treated with antibiotics.
2. *Evaluation of the intake of maternal antibodies administered through colostrum in the first hours of life and assessment of calf housing conditions*. A minimum of 200 grams of IgG antibodies should be in colostrum administered (in small and frequent feeding) in the first 6 hours after calving. Colostrum from the calf's mother will be preferred in feeding. Calves will be housed in individual boxes or hutches in the first weeks of life and regrouped in pens of 7-10 calves of the same age. All surfaces of the boxes and hutches must be easily cleaned. Leakage of urine and faeces from one box to another should be avoided (Dewolf & Van Immerseel, 2019).
3. *Assessment of the transition period in dairy cows*. The activity will cover the three weeks before calving and three weeks after calving. In the last three weeks of gestation, the cow's body is subjected to the pressure given by the rapid growth of the foetus and the synthesis of milk components for the next lactation. At the beginning of lactation, cows mobilize body reserves (5-8% of birth weight), appetite is low and capricious (intake decrease with 45%).

The identification of the deficiencies in work organization and equipment that may affect internal biosecurity involved two activities:

1. *Identify deficiencies in work organization that may affect internal biosecurity*. To prevent or reduce the risk of diseases transmission by direct and indirect contact, calves and adult cattle will be housed in different stables, or they will be completely separated, without physical contact and at a distance of at least 3 meters between boxes. To prevent the continued spread of pathogens among calves, they will be grouped according to age and not by growth rate and weight. In a stable, the calves will be positioned so that the direction of propagation of the air flows will be from the younger calves to the older animals. The changing clothes and washing hands between each age group of animals will be developed in a way to increase physical barriers from an age group to another.
2. *Identify equipment deficiencies that may affect internal biosecurity*. Feeding tools are cleaned and disinfected after each use. The farm will use specific equipment for each age group and will not share tools with other farms.

MAFHP of DF4

The BioCheck scoring tool revealed values around 50% in the subcategory “Feed and water” (50%) of the external biosecurity and the subcategory “Calving management” (20%), of the internal biosecurity (Figure 4). MAFHT provided advice on the feed and water biosecurity and calving management when the activities of the MAFHP goals were established.

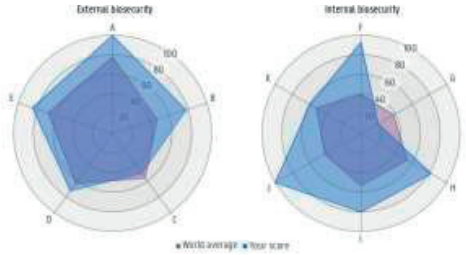

Figure 4. Subcategories scores of the internal and external biosecurity obtained by using the biosecurity scoring system Biocheck.UGent™ in DF4 (A. Purchase and reproduction; B. Transport and carcass removal; C. Feed and water; D. Visitors and farmworkers; E. Vermin control and other animals; F. Health management; G. Calving management; H. Calf management; I. Dairy management; J. Adult cattle management; K. Working organisation and equipment)

The MAFHP of DF4 has the following goals: (1) Feed and water biosecurity and (2) Management of calving and calf.

The activities of the goal Feed and water biosecurity were:

1. *Monitoring the risk of manure contamination during the crop or pasture fertilization*. The farmer will continuously check the fertilization of the land used for fodder production. It is considered that the contamination of feed with pathogens and/or (myco-) toxins can occur at all stages of feed production and storage. The feed can also be contaminated with manure during their fertilization or adjacent pastures. All feeding tools should be cleaned after each use to remove debris.
2. *Monitoring of manure storage (platform), place and form of storage of feedstocks*. The farmer will continuously check the storage of manure (platform), the place and form of storage of feedstocks. To avoid contamination of feed and water by rodents, birds, dogs, and cats, access to the stables, manure storage facility and feed storage facility will be limited.
3. *Monitoring the risk of manure contamination of feed purchased from other producers*: The farmer will continuously check the fertilization of the land used for fodder production and will assess the risk of contamination with manure from neighbouring lands.

MAFHP of DF5

The BioCheck scoring tool revealed values around 50% in the subcategory "Vermin control and other animals" (28%) of the external biosecurity and all subcategories of the internal biosecurity (Figure 5). MAFHT provided advice to improve internal biosecurity measures and recommended the organisation of a "Stable school" by using Vaarst et al. (2007) model.

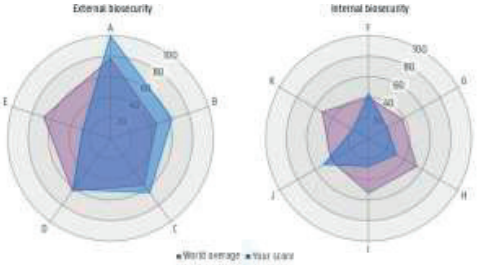

Figure 5. Subcategories scores of the internal and external biosecurity obtained by using the biosecurity scoring system Biocheck.UGent™ in DF5 (A. Purchase and reproduction; B. Transport and carcass removal; C. Feed and water; D. Visitors and farmworkers; E. Vermin control and other animals; F. Health management; G. Calving management; H. Calf management; I. Dairy management; J. Adult cattle management; K. Working organisation and equipment)

MAFHP's goals are (1) to identify issues that may affect the management of calving and calving and (2) identify deficiencies in work organization and equipment that may affect internal biosecurity.

The identification of the issues that may affect the management of calving and calving was done in the following activities:

1. *Analysis of the possible transmission of diseases through direct and indirect contact*. More attention will be paid to biosecurity measures that avoid direct contact between animals (Wells et al., 2002; Dewolf & Van Immerseel, 2019). The farm will evaluate the risk of disease transmission through direct and indirect contact between calves, young stock, and adult cattle: building a new stable or the compartmentalization of existing ones, using farm-specific boots and clothing, washing hands, use of disposable syringe and needles.
2. *Evaluation of the intake of maternal antibodies administered through colostrum in the first hours of life*. Farm must provide calves with a good volume of clean, high-quality colostrum within the first six hours of life (Godden et al., 2019). The mother's

colostrum obtained from the first milking will be the first option in the feeding of calves, and the use of colostrum from other farms will not be advised (Dewolf & Van Immerseel, 2019).

3. *Assessment of calf housing conditions*.

The identification of the deficiencies in work organization and equipment that may affect internal biosecurity was done in the subsequent activities:

1. *Identify deficiencies in work organization that may affect internal biosecurity*. Treatment of sick or injured animals will be done at the end of the daily routine.
2. *Identify equipment deficiencies that may affect internal biosecurity*: The farm will use age-specific materials and feeding tools. Labelling the materials and feeding-specific tools is proposed by MAFHT.

MAFHT's practitioners considered the general recommendations regarding the holistic approach to disease control, considering the epidemiology of diseases and the specific situations of each farm including the risks and perceptions of risk by decision-makers (Dargatz et al., 2002; Wells et al., 2002; Dewolf & Van Immerseel, 2019). In this study, al MAFHTs identified the farm practices to reduce bacterial disease and developed MAFHP tailored to specific situations in correlation with the results of the Biocheck.UGent™ and teams' meetings.

CONCLUSIONS

Farmers usually face management and/or health problems in correlation with the age category and physiological condition. The most common calf diseases were respiratory and enteric, but these problems did not create severe outbreaks of disease. Large dairy farms are more common with hoof disorders while small dairy farms are more exposed to udder diseases. All teams demonstrated their ability to identify farm practices to reduce bacterial disease and the need to use antibiotics.

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