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IMPLEMENTATION OF BIOSECURITY MEASURES IN RUMINANTS FARMS

PRIMENA BIOSIGURNOSNIH MERA NA FARMAMA PREŽIVARA

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ABSTRACT

Biosecurity is the result of all activities designed not only to prevent the introduction and spread of infectious diseases within and between herds, but ultimately to contribute to public health and food safety. Although experts and government agencies recommend the implementation of biosecurity practises on dairy, beef and sheep farms, their use appears to be limited. There is serious lack of training and consequently, rather low level of awareness of biosecurity risks among farmers. They are aware of necessity of good health of animals, but they mostly think of endemic diseases like mastitis, claws disorders, digestive problems, etc.). It seems that they are not aware of contagious disease risks, so pathogens models of spreading and entrance doors in to individual animal or population have to be pointed out. Farmers' opinion is that the government should have a greater input into biosecurity; veterinarians saw the ability or willingness of their clients to invest in biosecurity measures as a major barrier. Therefore, additional evidence of the effectiveness and/or potential economic benefits of proposed on-farm biosecurity measures have be better demonstrated. That would give a solid base for field veterinarians and their organisations to be more proactive in promotion and spreading of information on biosecurity, in both direct contact with farmers and organized training. This important role should be fulfilled in cooperation with farmers associations and veterinary authorities. A legal framework can be helpful, as well as stimulating measures for those who actively and successfully embrace biosecurity concept in their work. In many cases there are problems regarding biosecurity procedures application, particularly in control of movement of humans, animals, vehicles and equipment. Procedures have to be performed much more persistent and in responsible manner, particularly during summer, when field works take a lot of farmers' time. Biosecurity procedures must be more serious and determined as approaching to the object of protection.

Key words: biosecurity, measures, ruminants, farm, implementation

INTRODUCTION

Biosecurity is the result of all activities designed not only to prevent the introduction and spread of infectious diseases within and between herds, but ultimately to contribute to public health and food safety (1). Increasing awareness and attention was initially the result of the livestock industry's efforts to cope with diseases for which vaccines do not exist or have serious limitations (2).

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Although term "biosecurity" refers to management practises to prevent the introduction and spread of infectious diseases (2,3), it has no Oxford English dictionary definition. Interested parties have not only created and adapted different definitions to suit their own particular needs, but it seems that farmers and vets have their own relatively clear definitions of biosecurity in relation to some important diseases that threaten farming, which do not completely match (1).

The mentioned practises related to activities associated with the movement of animals, including the transport vehicles used and the isolation or treatment measures carried out after animals were moved to a holding. Also, biosecurity measures in relation to the sharing of equipment between farms are implemented by producers, as well as all preventive measures implemented by representatives of visiting companies and contractors. In addition, waste disposal and animal access to watercourses (streams, rivers, etc.) need to be taken into account, not to mention practises to reduce the transmission of pathogens within the farm were also analysed, particularly in relation to housing, staff and vehicles on the farm (1).

Although experts and government agencies recommend the implementation of biosecurity practises on dairy farms (4), their use appears to be limited. Rarely used practises include, for example, screening for disease and isolation of new and returning animals, controlling access of visitors or requiring them to wear special footwear and clothing, and using the sick barn exclusively for sick animals (5). As it was mentioned, farmers and vets have their own relatively clear definitions of biosecurity in relation to some important diseases that threaten farming, which do not completely match in the UK. Overall, farmers feel that other stakeholders, such as the government, should have a greater input into biosecurity in Great Britain. Conversely, veterinarians saw the ability or willingness of their clients to invest in biosecurity measures as a major barrier. Veterinarians also felt that additional evidence of the effectiveness and/or potential economic benefits of proposed on-farm biosecurity measures needed to be better demonstrated. The ancillary industries were generally unsure of the role they should play in biosecurity, although study participants highlighted zoonoses as part of the problem and indicated that most of the barriers were at farm level (1).

Even if veterinarians' attitudes towards best on-farm biosecurity practises for large and small ruminants are very sound and scientifically based, there may be some discrepancies and contradictions in their practises. Veterinarians sometimes misjudge their clients' opinion of importance and usefulness of biosecurity. This can lead to mistrust and confusion among farmers and affect their awareness and attitude to act in a timely and correct manner and to follow the proposed biosecurity measures and programmes. Farmers may consider biosecurity measures to be expensive and cumbersome and biosecurity routines at farm level are not always optimal. In some cases (*e*.g. newly introduced diseases), veterinary authorities may also react cautiously or inappropriately due to a temporary lack of reliable information and may be unaware of their ability to improve biosecurity levels on farms through training and sanctions (6,7). Farmers are more likely to act on the information provided by trusted advisors such as vets or by someone with whom they have built up a trusting relationship (8).

ASSESSMENT METHODS

Likewise to creation biosecurity measures, the assessment of their use and efficacy is based on epidemiology knowledge. Central to disease control is the identification of these patterns and the risk factors that increase the likelihood of disease outbreaks, as well as the factors that reduce the likelihood of disease outbreaks, so that measures can be taken to prevent or at least reduce the occurrence, severity and impact of disease (9).

Due to the need to prioritise the surveillance, control and eradication of infectious diseases, many prioritisation or categorisation exercises have been carried out in recent years. Given the lack of prevalence data for most cattle diseases, most of studies have followed the Delphi method (10), which is based on: (a) the establishment of an initial list of diseases, (b) the development of a prioritisation methodology that is translated into a questionnaire, and (c) the ranking or assessment of the different diseases by a panel of experts. This is basically a consensus approach, with many advantages, *e.g*. no need for scientific evidence as it relies on expert opinion, which can be changed through debate, and avoids personal and political influence as consensus is required (11). On the other hand, it should be noted that the opinion and experience of experts cannot replace a confirmatory

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scientific study in all cases, such as multipathogen diseases such as mastitis, respiratory diseases, and diarrhoea, which are usually a major concern for both animal and public health and should not be automatically omitted.

To assess the level of biosecurity on the farm, it is most logical to assess the infection risks for the farm population and its production. For this purpose, Hristov and Stanković (12) developed rather simple and useful questionnaires for cattle, pig and poultry farms. The cattle farm questionnaire is based on 13 indicators (farm biosecurity plan, location and isolation level, introduction of newly acquired animals into the herd, traffic control, attitude towards visitors, feeding and watering control, manure management, attitude towards other animals, rodents and birds' control and sanitation) scoring measure of accomplishment using marks 0-5 (0 – insufficient with no possibility, up to correct, to 5 – excellent), giving average grade for particular farm biosecurity level, expressed from 1 (insufficient, for average score of indicators, 0-1,99) to 5 (excellent, for average score of indicators, 4,50-5). The cattle farm assessment is accompanied with SWOT analysis, which takes into account all remarks when assessing any of individual indicators, suggestions how to improve biosecurity level on the farm.

Nowadays, to assess biosecurity on different types of cattle farms in the most of countries is being used the Biocheck Cattle tool, developed by Damiaans et al. (13). This questionnaire was based on a list of 47 priority diseases for cattle and the risk factors and biosecurity measures associated with these diseases (11), with 19 categories with a total of 304 questions (13).

Lewerin et al. (14) developed the tool to calculate the impact of different biosecurity measures and strategies at the individual farm level. To illustrate the general applicability of the tool, it was applied to theoretical examples of Swedish cattle farms and diseases endemic to these species in the EU in two scenarios with different contact patterns between farms.

BIOSECURITY MEASURES IMPLEMENTATION RESULTS

Biosecurity measures are based on epidemiological principles, and knowing routs of infections and entrance "doors" is crucial for their effectiveness. A key principle of veterinary epidemiology is that diseases do not occur randomly in a population, but in certain members/groups, at certain times and in certain places; diseases follow certain patterns (15). Based on international and national animal health authorities, certain biosecurity measures that contribute to a disease eradication or control programme are mandatory (e.g. winter screening in Belgium to detect potential carriers or vectors and purchased tests for some diseases), while others should be carried out on a voluntary basis (16). Biosecurity practices might differ among and within countries for reasons such as differences in production types, diseases present, legislation on disease control, and available resources (17).

The relationships between direct and indirect causes, factors or attributes and diseases outbreaks are often described as a causal network (18). One of the simplest models of disease causation is the epidemiological triad, the traditional model for infectious diseases (15). This triad consists of an external pathogen, a susceptible host and an environment, including management and husbandry practises that bring the host and pathogen together, where the disease results from the interaction between the pathogen and the susceptible host in an environment that supports the transmission of the pathogen from a source to the host (18).

The mode of transmission, the presence and survival of environmental stages and the presence of reservoirs, carriers and vectors also influence the spread and disease control measures (15). The presence of wildlife can play an important role in the transmission of certain diseases to humans and other animals by serving as vectors for pathogens such as rabies, leptospirosis and paratuberculosis agents (19) or as hosts for parasites such as *Echinococcus spp* (20). Vectors are fundamental for the certain pathogens transmission, such as bluetongue, became more dangerous due to the effects of climate change (21). Finally, the long-term survival of pathogens in the environment is crucial for the spread and persistence and may be used to predict disease emergence (15).

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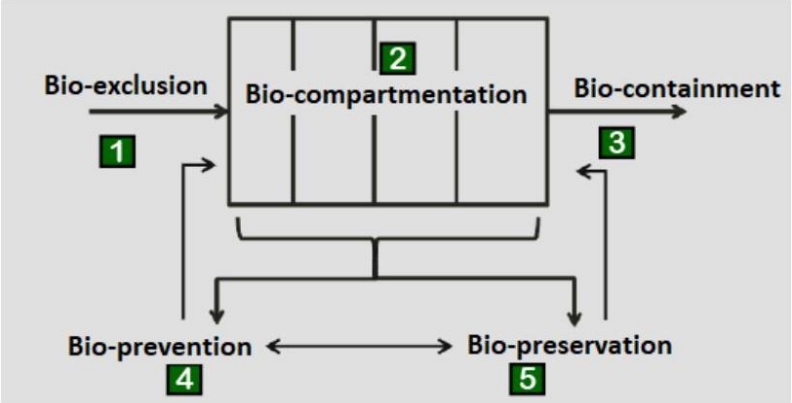

Figure 1. Biosecurity principles and compartments in animal facilities (22)

Biosecurity in animal production can be described through 5 compartments (22), in order to emphasize its importance in protecting animal health, public health and the environment (Figure 1.):

1. Bio-exclusion: biosecurity measures preventing the introduction of a pathogen in a farm,
2. Bio-compartmentation: biosecurity measures preventing the spread of a pathogen within the farm,
3. Bio-containment: biosecurity measures preventing the spread of the pathogen to other farms or premises,
4. Bio-prevention: biosecurity measures preventing the spread of zoonotic pathogens to humans, and
5. Bio-preservation: biosecurity measures preventing environmental contamination(s).

Biosecurity measures are regrouped into different categories and can be related to one or several biosecurity compartments. As an example, applying quarantine for newly purchased animals will contribute to bio-exclusion while a proper carcass disposal system will contribute to bio-compartmentalisation, bio-containment, bio-prevention and bio-preservation (23).

The study of Ferreira et al. (24) described the general and specific biosecurity measures for bovine virus diarrhoea and bovine herpes virus type 1 infection in Campos Gerais region of Paraná, Brazil, and demonstrated their association with the size of dairy farms. The answers, principally those on the access control for people, animals, and vehicles, animal quarantine and isolation, and hygiene practices, varied considerably among the farmers. Biosecurity measures have been poorly adopted in dairy farms. Small dairy farms had the lowest degree of biosecurity. This trend is also observed in dairy, mixed (dairy and beef), and small ruminant farms, which was in accordance with findings of Can and Altuğ (25), who reported the increase in biosecurity with the farm size. Only 15% of farms had visitor policies in place, of which only 4% were small- and medium-size farms. The lack of designated vehicle-parking areas was more common on small farms, and entry of trucks carrying animals for slaughter or disposal was more common on medium-size farms. The practice of purchasing animals was mainly found in medium and large farms (61% and 75%, respectively), which is serious risk factor for small- and medium-size farms for the introduction and spread of BVDV (26). Large farms implement significantly less bioexclusion measures, despite the greater impact of an infectious disease being introduced into the herd (16), so isolation of animals before any contact with domestic herd is necessary, as well diagnostic tests during the quarantine. Additionally, when transporting animals, it is important to avoid mixing batches from different farms and to sanitize the interior and exterior of the transport vehicles. Regarding hygiene practices, sharing of machinery for handling waste and feeding animals was found in most cases, regardless of the size of the production system. Cleaning and disinfection procedures of stalls and vehicles as well as hand washing before handling animals was extensively noticed in medium-size farms, which is essential to prevent the spread of pathogens.

Sahlström et al. (27) found that quarantine was more widely adopted in beef farms than in dairy farms, and was also associated with the size of the production systems. According to Hoe and Ruegg (28), bigger farms isolate sick animals more easily and carry out more diagnostic tests or examinations when new animals are acquired.

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Due to the limited alternatives to antimicrobials, biosecurity measures are necessary to ensure their appropriate use. Study of Ferreira et al. (24) found that the most frequently used chemotherapeutics for respiratory diseases in small- and medium-size farms were quinolones and macrolides, whereas large farms preferred amphenicols and macrolides. Large farms tend to use more antimicrobials. Some measures to reduce their use on dairy farms include: cleaning and disinfecting facilities, using replaceable bedding materials, avoiding contact with other farms, and undertaking proper quarantine when introducing new animals, and proper management of mammary gland health (29). Generally, small farms do not have any biosecurity practices in place or avoid certain risk factors, owing to their small size. Medium-size farms are in transition with only a few biosecurity measures. Large farms have the most biosecurity measures, but they face fundamental risk factors owing to the expansion of their farms. When consider the risk score obtained, it is obvious how few biosecurity measures are adopted in general, as the risk levels obtained were high and medium-high.

Biosecurity measures are identified based on the transmission pathways of infectious diseases and risk factors (23). Some of them are disease-specific (*e.g.* vaccination protocols), but the majority of biosecurity measures are generic and contribute to reducing the risks related to several infectious diseases, either by preventing their introduction (*e.g.* applying a quarantine), blocking the transmission pathways (*e.g.* isolation of sick animals) or by reducing the overall infection pressure (*e.g.* general hygiene).

By manipulating the environment, for example by reducing faecal contamination, reducing overcrowding or eliminating carriers or vectors of pathogens, we can reduce disease (20,30), as well as selecting animals resistant to disease or by increasing the resistance of the population through natural or artificial means (15) the severity of the disease may be reduced and thus the impact of the disease. In addition, information about certain host factors, such as age and sex, closely associated with many diseases, is useful for predicting infections within a population or group of animals, and helps to adjust and implement disease control programmes.

Oliveira et al. (31) pointed out insufficient biosecurity adoption in 16 Danish dairy herds, which is risks to animal and human health, besides raising concerns about compromised productivity and animal welfare. Recognized biosecurity practices to prevent introduction and spread of infectious diseases in the herds were broadly discussed by farmers, *e.g.* maintenance of a closed herd status and routines to ensure improved hygiene when handling animals and in the facilities. However, there are farmers expressing relaxed biosecurity attitudes under situations such as the herd's location in a region supposedly less threatened by diseases, need for increased herd size, and values related to keep a farming system without excessive restrictions. Other potential constraints for correct biosecurity adoption included difficult communication between farmers and their employees and visitors, lack of knowledge regarding infection routes, and financial limitations. The farmers received information about biosecurity from several sources, veterinarians being considered the main and trusted one. Beneficial views on the legislation appeared as a way to guarantee mutual adoption of biosecurity among farmers, whereas others believed that legislation might not be needed. Findings of this study showed that, in general, important biosecurity aspects were recognized by the farmers.

Lewerin et al. (14) study model showed that the most important factors influencing the risk and impact of biosecurity measures such as quarantine routines and protective clothing are the frequency of contact between farms and the prevalence of the disease. The risk of introduction and the effect of biosecurity measures varied depending on the type of farm and the transmission route of the disease. The risk assessment model proved useful to illustrate the risk of endemic disease introduction and the mitigating effect of different biosecurity measures at farm level. The results of the model could be used to justify and help veterinary advisors understand farm-specific risks and motivate farmers to improve biosecurity on their farm, as it can be tailored to each farmer’s needs and preferences.

The Biocheck Cattle tool developed by Damiaans et al. (13) is based on risk factors and biosecurity measures related to priority cattle diseases and the results of a cross-sectional survey on Belgian farms with selected questions. The scoring system consists of three separate questionnaires containing 69 (veal), 104 (beef) and 124 (dairy) questions. Experts from different areas of veterinary medicine were asked to weight the different biosecurity categories and questions according to Gore's method. The resulting system provides biosecurity points per category (external

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and internal biosecurity) and sub-category (e.g. purchasing, transport, health management). The Biocheck tool was then used in a survey to assess biosecurity on 20 veal, 50 beef and 50 dairy farms.

Both internal and external biosecurity were categorised as low for all production systems, with low average total biosecurity scores of 39.7 points for veal (SD = 7.4), 44.3 for beef (SD = 8.4) and 48.6 points for dairy producing farms (SD = 8.1), of maximum score of 100 points. The scores for internal biosecurity were lower than for external biosecurity for all farm types. Veal farms scored significantly lower for "purchasing" than beef and dairy farms, while they scored higher for the other subcategories of external biosecurity. For dairy and beef farms, "purchase and reproduction" was the sub-category with the highest score. For internal biosecurity, "health management" was particularly low in the three farm types, while subcategories with more than 50 points were rare. These results prove that this tool can be used to assess the implementation of biosecurity on cattle farms in a standardised and reproducible way, enabling farms benchmarking and herd-specific advising.

The study by Renault et al. (16) reviewed the main findings of various studies conducted from 2015 to 2021 to analyse the biosecurity level on Belgian cattle farms, including the attitudes and behaviours of cattle farmers and farm veterinarians with regard to biosecurity measures. In particular, the aim was to carry out a SWOT analysis (strengths, weaknesses, opportunities and threats) of the situation and to propose a new conceptual framework to improve the level of biosecurity in the cattle sector. Biosecurity in cattle farming is still relatively low and faces numerous challenges. Its future improvement requires that the various stakeholders agree on common objectives and carefully consider animal, human and environmental health as well as socio-economic and cultural factors. Further cost-effectiveness studies are needed to identify the most important biosecurity measures and to convince stakeholders of their benefits and advantages. Cattle farmers rely mainly on rural veterinarians for technical advice and consider them as trusted informants. To promote these good practises more effectively, rural veterinarians need adequate guidance from the authorities, appropriate training in biosecurity and communication, and a favourable environment.

Nevertheless, whilst many of these studies advise the use of preventive procedures, they do not often provide evidence on the efficacies or cost-effectiveness of engaging in such practices (3). The considerable differences in recommendations across publications can lead to confusion among farmers, resulting in them adopting less appropriate practises, which are 'favoured' or easy to implement, but not necessarily the most effective for the farm in question (32).

Biosecurity routines at herd level may reduce the probability of introduction of disease into the herd, but some measures may be regarded as expensive and cumbersome for the farmers (14). Custom-made measures based on individual farm characteristics may aid in improving the actual application of on-farm biosecurity (6,7).

Several aspects, one of which is the perception of the effectiveness of these practises, influence the adoption of preventive behaviour, thus limiting the adoption of biosecurity practises on dairy farms worldwide.

According to Herrmann et al. (33), the implementation of management activities on beef and dairy farms in Germany depend both on the attitude of the people performing the work, and their understanding of why the work should be performed. In the context of animal husbandry, the implementation of such practices is crucial for the functionality of biosecurity. These authors conducted anonymous online survey German farmers and concluded that, in general, farmers are aware of the importance of biosecurity and consequently had concepts of farm biosecurity, which reflected in the current European legislation, since "the operators of farms are responsible for minimizing the risk of the spread of diseases". On the other hand, awareness about introduction routes for animal diseases into a farm was associated with a lack of knowledge of how to improve the measures in these areas. This confirms role of the veterinarian in the context of biosecurity. Overall, the high level of farmers commitment indicated a good implementation of daily practices.

The study of Denis-Robichaud et al. (34) on general understanding of biosecurity and perceptions of the effectiveness of specific biosecurity practises (17 of them) was conducted in 2015 with 368 Canadian dairy farmers. It included correlations between perceptions of the effectiveness of each biosecurity practise and its implementation on the farm. Most respondents felt that the purpose of on-farm biosecurity was to prevent both the introduction of a new pathogen and the spread of an

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existing pathogen (73%) and felt that general biosecurity was effective (92%) and important (58%). Farmers considered most biosecurity measures to be effective (60–94%). Practises related to direct animal-to-animal contact were considered effective by more respondents than biosecurity practises related to contagion and visitors. Less than 20% of them reported having discussed the various biosecurity practises with a veterinarian and less than 60% reported using these practises on their farm. Finally, the reasons given by most farmers for implementing biosecurity measures were that (1) the measure helps to prevent the introduction or spread of a disease regionally and (2) it has been shown to benefit animal health and welfare. These results indicate that the effectiveness of certain biosecurity practises is perceived positively; there may be a lack of understanding of the practises that affect disease transmission through indirect contact, and that the perceived threat of not implementing practises is minimal.

An on-line survey of Renault et al. (11) was implemented in Belgium, France and Spain in order to assess the behaviour of rural veterinarians towards biosecurity, and implementation level of the biosecurity measures. The study identified different strengths, weaknesses, possible constraints and solutions in terms of veterinary perspectives. Veterinarians are considered as key information sources by the farmers, so they should be more active in terms of guidance and improvement of biosecurity at farm level. Two factors seemed to influence significantly the implementation level of measures: the country of practice and the veterinarian's perception level of biosecurity. The biosecurity stages with the lowest application level, therefore the highest risk were bio-exclusion, increasing the risk of disease introduction, and bio-containment, increasing the risk of inter-herd transmission. Based on this analysis, an initial diseases list needs urgent attention in this part of Europe, since they are all zoonoses: Crimean Congo haemorrhagic fever, Ebola virus disease, Marburg haemorrhagic fever, Lassa fever, Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS), Nipah virus disease and Rift Valley Fever. The study highlighted the areas of improvements.

Biosecurity infrastructures (*e.g*. calving areas, isolation stall) are rarely available in farms. The main weaknesses that should be corrected are linked to bio-exclusion and bio-containment that is footbath and cleaning facilities for visitors, quarantine for newcomers, control of visitors and contacts with other domestic species and wildlife. Regarding the veterinary practices, the current implementation level is rather low, so there is a large place for improvement, for instance, organising the visits on the basis of contamination risks (16).

Using a modified Delphi method, Kuster et al. (17) asked 8 Swiss livestock disease specialists to rank biosecurity measures by allocating a score from 0 (lowest) to 5 (highest) based on their importance related to Swiss legislation, feasibility, as well as the effort required for implementation and the benefit of each biosecurity measure. The biosecurity measures were ranked based on their effectiveness in preventing an infectious agent from entering and spreading on a farm, solely based on transmission characteristics of specific pathogens: bluetongue, bovine viral diarrhoea, foot and mouth disease and infectious bovine rhinotracheitis. For cattle farms, biosecurity measures that improve disease awareness of farmers were ranked as both most important and most effective. Among all single measures evaluated, education of farmers was perceived by the experts to be the most important and effective for protecting Swiss cattle farms from disease. Authors identified the distinction between the terms "importance" and "effectiveness" of biosecurity measures, demanding further research on the effectiveness of biosecurity measures. They call attention to the need for more precise and commonly accepted definitions of biosecurity measures, which would facilitate communication to farmers and policy makers on the value of on-farm biosecurity.

The findings of this study provide an important basis for recommendation to farmers and policy makers. The Swiss approach to maintaining a disease-free livestock population is dominated largely by governmental control measures, with the compulsory bluetongue vaccination in 2008–2010 and the ongoing bovine virus diarrhoea eradication program being notable examples (35,36). In contrast, the implementation of on-farm biosecurity measures in Switzerland is relatively poor. This may be associated with the fact that Swiss livestock herds are still small, despite the global trend towards fewer and bigger enterprises, on average 39 in 2011.

Nöremark and Sternberg-Lewerin (37) investigated professionals visiting animal farms in Sweden perception of the farm biosecurity, the factors that influence their own biosecurity routines and what they describe as obstacles for biosecurity,

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as well as suggestions for improvements. In all groups, a majority of the 386 respondents perceived obstacles for on-farm biosecurity, among veterinarians 66% perceived that there were obstacles, mainly related to the very basics level of biosecurity, such as access to soap and water. Responsibility was identified to be a key issue; while some farmers expect visitors to take responsibility for keeping up biosecurity they do not provide the adequate on-farm conditions. Visitors need to take responsibility for avoiding spread of disease, while farmers need to assume responsibility for providing adequate conditions for on-farm biosecurity.

Toma et al. (38) performed telephone survey on impact of determinants of biosecurity behaviour of 900 cattle and sheep farmers in Great Britain. Their results suggest that farmers' perceived importance of specific biosecurity strategies, organic certification of the farm, knowledge of biosecurity measures, attitudes towards animal welfare, perceived usefulness of biosecurity information sources, perceived impact of severe animal disease outbreaks on the farm in the last five years, membership of a cattle/sheep health programme, attitudes towards biosecurity in animal husbandry, influence on the decision to apply biosecurity measures, experience and economic factors significantly influence behaviour (explaining 64% of the variance in behaviour overall). Numerous studies have shown that farmers make different management decisions at different stages of their lives. Younger farmers with large herds and few dependants are more willing to participate in an eradication programme, whereas older farmers with no offspring are more unwilling to make changes to their management systems (39). Education, experience and cognitive ability are all variables that have a significant impact on the decision making process and are often related to the age of the decision maker. In addition, education and training have been shown to improve and influence farmers' willingness to implement a change in management practises (40). Farmers who experienced disease outbreaks in the past are more likely to use sources of information and apply more biosecurity measures currently on their farms. In addition, farmers who are members in cattle and/or sheep health schemes are likely to apply more biosecurity measures on their farms.

Small-scale family type farms play an important role in the development of the rural economy, reducing poverty among farmers, especially in developing countries. However, this category of producers has faced numerous financial, technical, and legal challenges during last decade (41).

According to Can and Altuğ (25), biosecurity plays a crucial role in preventing contagious diseases and in increasing farm productivity. They conducted on a total of 50 small-scale dairy farms in Hatay, Turkey, in order to determine technical and economic biosecurity scores of farms, and to examine the associations between biosecurity practices and producers' socioeconomic characteristics, using a checklist related to 19 biosecurity practices, using the technical and economic scoring systems of presence and cost of the each of the biosecurity practices. They found that treatment of sick animals (98%), vaccination against the most common contagious diseases (90%), and barn lime (86%) were found to be the most commonly used applications, while testing for the most common contagious diseases before buying (10%) was used at the lowest rate. The authors found significant differences among the groups regarding education level (<.05), income class (<.05), and herd size (<.01). Biosecurity scores were significantly positively correlated with herd size (<.05) and producers' education level (<.01). There were statistically significant associations between the producers' socioeconomic characteristics and some of the biosecurity practices. The authors concluded that training programs should intend to change the attitudes and perception of small-scale producers concerning poor biosecurity practices. In order to encourage producers to increase biosecurity scores, regulations regarding financial support and penalties could be quite useful at both the regional and national levels.

Analysis of biosecurity situation on Serbian dairy, beef and sheep farms of different capacity in graduation theses written by animal science students conducted by Hristov and Stanković during last decade reveals a lot of issues. Biosecurity level is mostly good or very good or seldom sufficient (average grades of farms were in range from 3.85 to 1.49). There is serious lack of training and consequently, rather low level of awareness of biosecurity risks. It indicates that they have to be familiar with pathogens models of spreading and entrance doors in to individual animal or population. Farmers take rather good care of general health of animals (*e.g.* mastitis, claws disorders, digestive problems, etc.), but it seems that they are not aware

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of contagious disease risks. Visitors control is quite liberal, which is general situation in Serbia. Required procedures can be performed much more persistent and in responsible manner, particularly during summer, when field works take a lot of farmers' time. Biosecurity procedures must be more serious and determined as approaching to the object of protection.

CONSTRAINTS AND LIMITATIONS OF BIOSECURITY PROCEDURES IMPLEMENTATION

Historically, the roles and responsibilities of government, industry and animal owners regarding disease control have been based on a set of assumptions that have not always resulted in the major stakeholders working together. Burrell (42) posed the question: "What can producers do to protect themselves regarding disease epidemics?" stating that the industry clearly had a major role to play. One plausible response has been the growth of independent biosecurity initiatives amongst motivated sheep and cattle farmers and between the farmers and their veterinary advisors in several regions of the UK (1).

Toma et al. (38) concluded that the stronger the farmers' attitude towards biosecurity, the more likely they are to apply biosecurity measures on their farms (namely that biosecurity measures are essential for keeping the herd healthy, that the application of biosecurity measures could save farmers a lot of money and that biosecurity regulations are good for animal health). The vast majority of veterinarians consider biosecurity to be a priority for their profession, although they do not consider their own safety to be at risk in their daily practise. This could pose a threat to public health as the seroprevalence for zoonotic diseases tends to be significantly higher among veterinarians in rural areas (43). The survey highlighted weaknesses and areas for improvement, particularly in relation to bio-exclusion (in relation to the risk of disease introduction) and bio-containment (in relation to the risk of disease transmission between herds). In case they do not adopt good practices, veterinarians might be unsuccessful in one of their main responsibilities, to limit the spread of a disease in case of outbreak, and be a high risk for farmers by iatrogenic route of transmission of diseases in premises. Although veterinarians expressed different constraints, possible solutions exist and have already been implemented by some veterinarians, such as an autonomous and mobile decontamination system or farm-dedicated clothes, boots and/or surgical material boxes that are left on premises.

The lack of financial resources can be an important factor for small and medium-size farmers to (not) adopt certain biosecurity measures (44). Simple and cost-effective biosecurity measures can be readily implemented, including communicating access restrictions to visitors, enforcing proper handling of animals, and ensuring that visitors sanitize their hands, boots, and shoes before entering free stalls or bovine facilities. Additionally, having a designated parking area for vehicles is essential and should be emphasized. Cleaning and disinfection procedures are essential to prevent the spread of pathogens, especially it is necessary to clean and disinfect all vehicles that regularly enter a property. Daily cleaning and disinfection of trucks shared for transporting animals are crucial, although these measures may require significant financial investment or employee labour to implement those (24).

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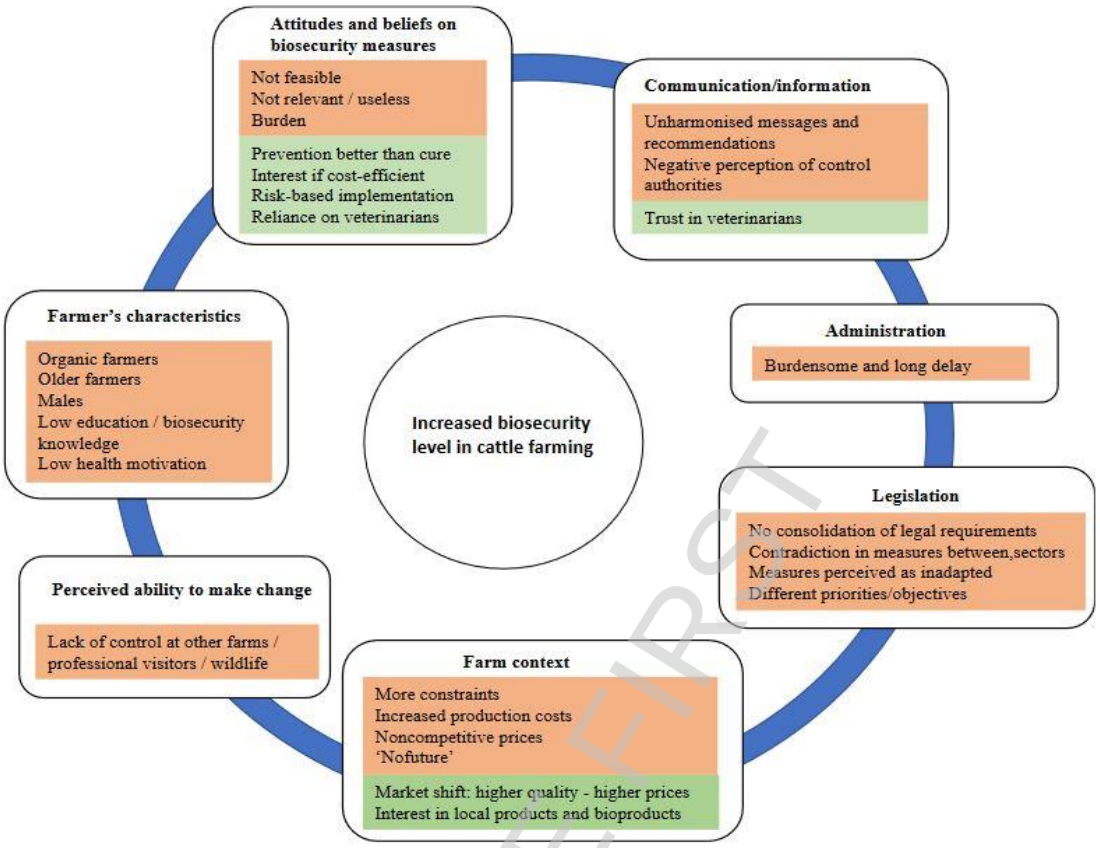

Figure 2. Proposed conceptual model explaining the factors affecting the implementation of biosecurity measures at Belgian cattle farms. In orange, negative-effect factors; in green, positive-effect factors (11)

Renault et al. (11) pointed out that several factors may negatively affect the implementation of biosecurity measures at cattle farms. They are related both to the farmer's attitudes and awareness and the administrative and legal circumstances. Based on this, several recommendations can be made in order to improve the biosecurity level at cattle farms, as it is may be concluded from Figure 2. Authors pointed out that there is an urgent need for evidence-based cost efficiency studies in order to identify the priority biosecurity measures and prove to the farmers of their cost efficiency (28). It was previously mentioned that the veterinarian's perception level of biosecurity measures influences significantly the adequate implementation of good practices. Therefore, it is essential to give biosecurity a greater role in veterinary training programs and curriculum, and to ensure an appropriate and progressive awareness emergent as part of continuing education proposed to veterinarians (11).

The identified measures have to be relevant, adequate, and practicable to the requirements of farmers. They should be shared with other stakeholders in order to stay away from possible contradictions (*e.g.*, removing elements of the "green belt" surrounding farm: bushes and vegetation for vector control, while environmental policy promote natural hedges and prevent vegetation removing). As for the One Health approach, biosecurity measures should be considered as comprehensive, as "a unified concept to integrate human, animal, plant and environmental health" (45). Negative impact of some preventive treatments on the environment or human health has been documented in the past, for instance the development of (multi)drug resistance related to the preventive use of antibiotics in some intensive farming system (46), the contamination of the environment related to treatments of animals with acaricides (47), and the negative effects on beneficial insects consecutive to the use of chemical larvicides in the control of vector breeding sites (48). Negative consequences could be avoided taking the One Health approach, connecting fields of health, agriculture and the environmental protection. Taking into account the natural and social sciences may facilitate the acceptance of biosecurity measures by

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the population (44). These aspects are clearly taken into consideration by the European Green Deal (49), which policy areas include, among other things, biodiversity (measures to protect the ecosystem) and food safety. In addition, effective training focused on chosen goals, and communication to farmers should take place ideally by reputable sources such as veterinary practitioners or farmers' associations, in order to promote biosecurity and the major biosecurity measures, arising stakeholders' knowledge and awareness and reliable legislative document. Last but not least, further studies should obtain convincing evidence of biosecurity measures cost efficiency and recommend the priority measures for their utility and benefits (16). In addition,

Successful implementation of the recommended management practices is related to the farmers risk perception, including acceptable risk and the associated consequences, and the significance of particular biosecurity measure (11). Therefore, the perceived effectiveness of the recommended guidelines, feasibility, and technical knowledge of the subject increase the likelihood of adopting the biosecurity measures in production systems (24). According to the Oliveira et al. (31), insufficient biosecurity adoption in dairy herds has been pointed out. This creates real risks to animal and human health, besides raising concerns about compromised productivity and animal welfare. Nevertheless, in general, farmers are familiar with important biosecurity aspects. Despite of this, factors limiting the adoption of biosecurity measures were present.

CONCLUSIONS

General remark of implementation of biosecurity measures on ruminants' farms worldwide is that it could be done much better. Although is evident that all stakeholders understand they have important role in herd health and production protection against pathogen agents and diseases outbreaks, their knowledge of procedures and measures that have to be undertaken is often very limited. There is serious lack of training and consequently, rather low level of awareness of biosecurity risks. Farmers are aware of necessity of good health of animals, but they mostly think of endemic diseases like mastitis, claws disorders, digestive problems, etc.); it seems that they are not aware of contagious disease risks. It indicates that they have to be familiar with pathogens models of spreading and entrance doors in to individual animal or population. Farmers' opinion is that the government should have a greater input into biosecurity; veterinarians saw the ability or willingness of their clients to invest in biosecurity measures as a major barrier. Additional evidence of the effectiveness and/or potential economic benefits of proposed on-farm biosecurity measures have be better demonstrated. That would give a solid base for field veterinarians and their organisations to be more proactive in promotion and spreading of information on biosecurity, in both direct contact with farmers and organized training. This important role should be fulfilled in cooperation with farmers associations and veterinary authorities. A legal framework can be helpful, as well as stimulating measures for those who actively and successfully embrace biosecurity concept in their work. In many cases there are problems regarding biosecurity procedures application, particularly in control of movement of humans, animals, vehicles and equipment. Procedures have to be be performed much more persistent and in responsible manner, particularly during summer, when field works take a lot of farmers' time. Biosecurity procedures must be more serious and determined as approaching to the object of protection.

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PRIMENA BIOSIGURNOSNIH MERA NA FARMAMA PREŽIVARA (PREVOD)

IMPLEMENTATION OF BIOSECURITY MEASURES IN RUMINANTS FARMS

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SAŽETAK

Biosigurnost je rezultat svih aktivnosti koje su osmišljene ne samo da spreče unošenje i širenje zaraznih bolesti unutar i između stada, već i da doprinesu javnom zdravlju i bezbednosti hrane. Iako stručnjaci i vladine agencije preporučuju primenu biosigurnosnih praksi na farmama mlečnih i tovnih goveda i ovaca, čini se da je njihova upotreba ograničena. Među odgajivačima postoji ozbiljan nedostatak obuke i, shodno tome, prilično nizak nivo svesti o rizicima biološke bezbednosti. Oni su svesni neophodnosti dobrog zdravlja životinja, ali uglavnom misle o endemičnim bolestima poput mastitisa, poremećaja kandži, problema sa varenjem itd.). Čini se da odgajivači nisu svesni rizika od zaraznih bolesti, pa bi ih trebalo upoznati sa načinima širenja patogenih uzročnika i ulaznim vratima infekcije kod jedinki i populacija. Mišljenje farmera je da bi vlada trebalo da ima veći doprinos u biosigurnost i; veterinari kao glavnu prepreku vide sposobnost ili spremnost svojih klijenata da ulažu u biosigurnosne mere. Zato bi dodatni dokazi o efikasnosti i/ili potencijalnoj koristi od predloženih mera biosigurnosti na farmi trebalo da budu bolje prikazani. To bi obezbedilo solidnu osnovu za terenske veterinare i njihove organizacije da budu proaktivniji u promovisanju i širenju informacija o biosigurnosti, i u direktnom kontaktu sa farmerima, tako i u organizovanju obuke. Ovu važnu ulogu treba ostvariti u saradnji sa udruženjima poljoprivrednika i veterinarskim vlastima. Pravni okvir može biti od pomoći, kao i podsticajne mere za one koji aktivno i uspešno prihvataju koncept biosigurnost i u svom radu. U mnogim slučajevima postoje problemi u vezi sa primenom biosigurnosnim procedurama, posebno u kontroli kretanja ljudi, životinja, vozila i opreme. Postupci se moraju izvoditi mnogo upornije i odgovornije, posebno tokom leta, kada poljski radovi oduzimaju mnogo vremena poljoprivrednicima. Postupci biosigurnosne zaštite moraju biti ozbiljniji i određeni kao približavanje objektu zaštite.

Ključne reči: biosigurnost , mere, preživari, farma, implementacija

UVOD

Biosigurnost predstavlja rezultat svih aktivnosti koje su osmišljene ne samo da spreče unošenje i širenje zaraznih bolesti unutar i između stada, već i da doprinesu javnom zdravlju i bezbednosti hrane (1). Povećanje svesti i pažnje u početku je bio rezultat napora stočara da se izbore sa bolestima za koje vakcine ne postoje ili imaju ozbiljna ograničenja (2). Iako se pojam „biosigurnost“ odnosi na prakse upravljanja koje imaju za cilj sprečavanja unošenje i širenje zaraznih bolesti (2,3), on nema definiciju Oksfordskog rečnika engleskog jezika. Zainteresovani ne samo da su kreirali i prilagodili različite definicije svojim posebnim potrebama, već se čini da farmeri i veterinari imaju svoje relativno jasne definicije biosigurnosti u odnosu na neke važne bolesti koje prete uzgoju životinja, a koje se ne podudaraju u potpunosti (1) .

Pomenute prakse su se odnosile na aktivnosti vezane za kretanje životinja, uključujući korišćena transportna vozila i mere izolacije ili tretmana koje

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se sprovode nakon preseljenja životinja na imanje. Takođe, mere biosigurnost i u vezi sa deljenjem opreme između farmi sprovode proizvođači, kao i sve preventivne mere koje sprovode predstavnici gostujućih kompanija i izvođača. Pored toga, potrebno je uzeti u obzir odlaganje otpada i pristup životinja vodotocima (potocima, rekama, itd.), a da ne pominjemo i prakse za smanjenje prenosa patogena unutar farme, posebno u vezi sa smeštajem, osobljem i vozila na farmi (1).

Iako stručnjaci i vladine službe preporučuju primenu biosigurnosnih praksi na farmama mleka (4), čini se da je njihova upotreba ograničena. Retko korišćene prakse obuhvataju, na primer, skrining na bolest i izolaciju novih i životinja koje se vraćaju na farmu, kontrolu pristupa posetilaca ili zahtev za njih da nose posebnunu obuću i odeću, uz korišćenje posebnih staja isključivo za bolesne životinje (5). Kao što je pomenuto, farmeri i veterinari imaju svoje relativno jasne definicije biosigurnosti u odnosu na neke važne bolesti koje prete poljoprivredi, a koje se u Velikoj Britaniji ne podudaraju u potpunosti. Sve u svemu, farmeri smatraju da bi druge zainteresovane strane, kao što je vlada, trebalo da imaju veći doprinos biosigurnosti na farmama u Velikoj Britaniji. Nasuprot tome, veterinari su kao glavnu prepreku videli sposobnost ili spremnost svojih klijenata da ulažu u mere biološke bezbednosti. Veterinari su takođe smatrali da je potrebno bolje demonstrirati dodatne dokaze o efikasnosti i/ili potencijalnim ekonomskim koristima predloženih mera biosigurnostina farmi. Pomoćne industrije generalno nisu bile sigurne u ulogu koju bi trebalo da imaju u biosigurnost i, iako su učesnici studije istakli zoonoze kao deo problema i ukazali da je većina barijera na nivou farme (1).

Čak i ako su stavovi veterinara prema najboljim praksama biosigurnosti na farmi za velike i male preživare veoma čvrsti i naučno zasnovani, mogu se pojaviti neslaganja i kontradikcije u njihovim postupcima. Veterinari ponekad pogrešno procenjuju mišljenje svojih klijenata o važnosti i korisnosti biosigurnosti. To može dovesti do nepoverenja i konfuzije među odgajivačima i uticati na njihovu svest i stav da deluju blagovremeno i ispravno i prate predložene mere i programe biosigurnosti.

Odgajivači mogu smatrati da su mere biosigurnostiskupe i glomazne, a i rutininske biosigurnosne mere na nivou farme nisu uvek optimalne. U nekim slučajevima (npr. bolesti koje se od skora pojavljuju), veterinarske vlasti takođe mogu reagovati oprezno ili neodgovarajuće zbog privremenog nedostatka pouzdanih informacija i mogu biti nesvesne svoje sposobnosti da poboljšaju nivoe biosigurnosti na farmama kroz obuku i sankcije (6,7). Veća je verovatnoća da će farmeri delovati na osnovu informacija koje im daju pouzdani savetnici kao što su veterinari ili neko sa kim su izgradili odnos poverenja (8).

METODE PROCENE

Kao i kod osmišljavanja biosigurnosnih mera, procena njihove upotrebe i efikasnosti zasniva se na poznavanju epidemiologije. Ključno u kontroli bolesti je prepoznavanje obrazaca širenja bolesti i faktora rizika koji povećavaju verovatnoću izbijanja, kao i faktora koji smanjuju verovatnoću izbijanja bolesti, tako da se mogu preduzeti mere za sprečavanje ili bar smanjenje pojave, ozbiljnost i uticaj bolesti (9).

Zbog potrebe da se da prioritet nadzoru, kontroli i iskorenjivanju zaraznih bolesti, poslednjih godina su sprovedene mnoge vežbe sagledavanja prioriteta ili kategorizacije. S obzirom na nedostatak podataka o prevalenci za većinu bolesti goveda, većina studija je pratila Delphi metod (10), koji se zasniva na: (a) uspostavljanju početne liste bolesti, (b) razvoju metodologije prioritizacije koja se prevodi u upitnik, i (c) rangiranje ili procena različitih bolesti od strane panela stručnjaka.

Ovo je u osnovi pristup konsenzusom, sa mnogo prednosti, gde na primer nema potrebe za naučnim dokazima jer se oslanja na stručno mišljenje, koje se može promeniti kroz debatu, i izbegava lični i politički uticaj pošto je potreban konsenzus (11). S druge strane, treba napomenuti da mišljenje i iskustvo stručnjaka ne mogu zameniti potvrdnu naučnu studiju u svim slučajevima, kao što su multipatogene bolesti kao što su mastitis, respiratorna oboljenja i dijareja, koji obično predstavljaju veliku zabrinutost i za životinje i za životinje. javno zdravlje i ne bi trebalo automatski da se izostavi.

Da bi se procenio nivo biosigurnosti na farmi, najlogičnije je proceniti rizike od infekcije za populaciju farme i njenu proizvodnju. U tu svrhu Hristov i Stanković (12) su razvili prilično jednostavne i korisne upitnike za farme goveda, svinja i živine. Upitnik farme goveda je zasnovan na 13 indikatora (plan biosigurnost i farme, lokacija i nivo izolacije, uvođenje novonabavljenih životinja u stado, kontrola saobraćaja, odnos prema posetiocima, kontrola hranjenja i pojenja,

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upravljanje stajnjakom, odnos prema drugim životinjama, glodarima i kontrola ptica i sanitacija) bodovanje mera postignuća koristeći ocene 0-5 (0 – nedovoljno bez mogućnosti, do tačne, do 5 – odlično), dajući prosečnu ocenu za određeni nivo biosigurnosti farme, izraženu sa 1 (nedovoljno, za prosek ocena indikatora, 0-1,99) do 5 (odličan, za prosečnu ocenu indikatora 4,50-5). Procena farme goveda je praćena SVOT analizom, koja uzima u obzir sve primedbe prilikom procene bilo kog pojedinačnog indikatora, sugestije kako da se poboljša nivo biosigurnost i na farmi.

Danas se za procenu biosigurnosti na različitim tipovima farmi goveda u većini zemalja koristi Biocheck Cattle alat, koji su razvili Damiaans i sar. (13). Ovaj upitnik je zasnovan na listi od 47 prioritetnih bolesti za goveda i faktora rizika i biobezbednosnih mera povezanih sa ovim bolestima (11), sa 19 kategorija sa ukupno 304 pitanja (13).

Leverin i sar. (14) su razvili alat za izračunavanje uticaja različitih mera i strategija biosigurnosti na nivou individualne farme. Da bi se ilustrovala opšta primenljivost alata, primenjen je na teorijske primere švedskih farmi goveda i bolesti endemskih za ove vrste u EU u dva scenarija sa različitim obrascima kontakta između farmi.

REZULTATI PRIMENE MERA BIOSIGURNOSTI

Mere biosigurnosti su zasnovane na epidemiološkim principima, a poznavanje puteva infekcija i ulaznih „vrata“ je ključno za njihovu efikasnost. Ključni princip veterinarske epidemiologije je da se bolesti ne javljaju nasumično u populaciji, već u jedinkama/grupama, u određeno vreme i na određenim mestima; bolesti prate određene obrasce (15).

Prema međunarodnim i nacionalnim autoritetima za zdravlje životinja, određene mere biosigurnosti koje doprinose programu iskorenjivanja ili kontrole bolesti su obavezne (npr. zimski skrining u Belgiji radi otkrivanja potencijalnih nosilaca ili vektora i kupljeni testovi za neke bolesti), dok druge treba sprovesti na na dobrovoljnoj osnovi (16). Praksa biosigurnosti se može razlikovati među zemljama i unutar njih usled razlika u tipovima proizvodnje, prisutnim bolestima, zakonodavstvu o kontroli bolesti i dostupnim resursima (17).

Odnosi između direktnih i indirektnih uzroka, faktora ili atributa i izbijanja bolesti često se opisuju kao uzročna mreža (18). Jedan od najjednostavnijih modela uzročnosti bolesti je epidemiološka trijada, tradicionalni model zaraznih bolesti (15). Ova trijada se sastoji od spoljašnjeg patogena, osetljivog domaćina i okruženja, uključujući postupke upravljanja i uzgoja koji spajaju domaćina i patogena, gde je bolest rezultat interakcije između patogena i osetljivog domaćina u okruženju koje podržava prenošenje patogen od izvora do domaćina (18).

Način prenošenja, prisustvo i opstanak razvojnih oblika i prisustvo rezervoara, nosilaca i vektora takođe utiču na širenje i mere kontrole bolesti (15). Prisustvo divljih životinja može igrati važnu ulogu u prenošenju određenih bolesti na ljude i druge životinje služeći kao vektori za patogene kao što su besnilo, leptospiroza i uzročnici paratuberkuloze (19) ili kao domaćini za parazite kao što je Echinococcus spp (20). Vektori su od suštinskog značaja za prenošenje određenih patogena, kao što je bolest plavog jezika, koja je postala opasnija zbog efekata klimatskih promena (21). Konačno, dugoročni opstanak patogena u životnoj sredini je ključan za širenje i perzistentnost i može se koristiti za predviđanje pojave bolesti (15).

Slika 1. Principi biosigurnosti i odeljenja u objektima za životinje (22) – pogledati englesku verziju rada

Biosigurnost u stočarskoj proizvodnji može se opisati kroz 5 elemenata (22), kako bi se istakao njen značaj u zaštiti zdravlja životinja, javnog zdravlja i životne sredine (Slika 1.):

1. Bio-isključenje: mere biosigurnosti koje sprečavaju unošenje patogena na farmu,
2. Bio-kompartmentacija: mere biosigurnosti koje sprečavaju širenje patogena unutar farme,
3. Bio-zadržavanje: mere biosigurnosti koje sprečavaju širenje patogena na druge farme ili prostorije,
4. Bio-prevencija: mere biosigurnosti koje sprečavaju širenje zoonotskih patogena na ljude, i
5. Bio-očuvanje: mere biosigurnosti koje sprečavaju kontaminaciju(e) životne sredine.

Mere biosigurnosti su pregrupisane u različite kategorije i mogu se odnositi na jedan ili više odeljaka biosigurnost i. Na primer, primena karantina za novokupljene životinje će doprineti bio-isključenju, dok će pravilan sistem odlaganja leševa doprineti bio-kompartmentalizaciji, biološkom zadržavanju, bio-prevenciji i bio-očuvanju (23).

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Studija Ferreira i sar. (24) je prikazala opšte i specifične mere biosigurnosti za bovinu virusnu dijareju i infekciju virusom goveđeg herpesa tipa 1 u regionu Campos Gerais u Parani u Brazilu, i pokazala njihovu povezanost sa kapacitetom farmi muznih krava. Odgovori u vezi kontrole pristupa za ljude, životinje i vozila, karantinu i izolaciji životinja i higijenskih praksi su se značajno razlikovali među farmerima. Mere biosigurnost i su loše usvojene na farmama muznih krava. Najniži stepen biosigurnosti imale su farme malog kapaciteta. Ovaj trend je primećen i na farmama muznih krava, farmama mešovitog tipa (mleko i meso) i farmama malih preživara, što je u skladu sa nalazima Cana i Altuga (25), koji su ustanovili povećanje nivoa biosigurnosti sa povećanjem veličine farme. Samo 15% farmi je imalo uspostavljen režim za posetioce, od kojih su samo 4% bila mala i srednja gazdinstva.

Nedostatak parkinga za vozila je bio češći na malim farmama, a ulazak kamiona koji su prevozili životinje na klanje ili odlaganje bio je češći na farmama srednje veličine. Praksa nabavke i uvođenja životinja uglavnom je uočena na srednjim i velikim farmama (61% i 75%, respektivno), što je ozbiljan faktor rizika za mala i srednja gazdinstva u pogledu unošenja i širenja BVDV (26). Velike farme sprovode znatno manje mera bioisključivanja, uprkos većem uticaju zarazne bolesti koja se unosi u stado (16), pa je neophodna izolacija životinja pre bilo kakvog kontakta sa domaćim stadom, kao i dijagnostički testovi tokom karantina. Pored toga, prilikom transporta životinja je važno izbegavati mešanje grupa poreklom sa različitih farmi i dezinfikovati unutrašnjost i spoljašnjost transportnih vozila. Što se tiče higijenske prakse, u većini slučajeva je konstatovano deljenje mašina za rukovanje otpadom i ishranu životinja između gazdinstava, bez obzira na veličinu proizvodnog sistema. Postupci čišćenja i dezinfekcije staja i vozila, kao i pranje ruku pre rukovanja životinjama, su uobičajeni na farmama srednje veličine, što je neophodno za sprečavanje širenja patogena.

Sahlström i sar. (27) su ustanovili da je karantin češće usvojena mera na farmama tovnih goveda nego na farmama muznih krava, a takođe je povezan sa veličinom proizvodnih sistema. Prema Hoe and Ruegg-u (28), veće farme lakše izoluju bolesne životinje i sprovode više dijagnostičkih testova ili pregleda kada se nabave nove životinje.

Zbog ograničenih alternativa antimikrobnim sredstvima, neophodne su mere biosigurnosti kako bi se obezbedila njihova odgovarajuća upotreba. Studija Ferreira i sar. (24) su otkrili da su najčešće korišćeni hemoterapeutici za respiratorne bolesti na malim i srednjim farmama hinoloni i makrolidi, dok na velikim farmama preovlađuju amfenikoli i makrolidi, uz primenu više različitih antimikrobnih sredstava. Mere za smanjenje njihove upotrebe na farmama mleka uključuju čišćenje i dezinfekciju objekata, korišćenje zamenljivog materijala za posteljinu, izbegavanje kontakta sa drugim farmama i preduzimanje odgovarajućeg karantina prilikom uvođenja novih životinja i pravilno upravljanje zdravljem mlečne žlezde (29). Uopšteno govoreći, male farme nemaju uspostavljene prakse biosigurnosti ili izbegavaju određene faktore rizika, zbog svoje male veličine. Farme srednje veličine su u tranziciji sa samo nekoliko mera biološke bezbednosti. Velike farme imaju najviše mera biološke bezbednosti, ali se suočavaju sa elementarnim faktorima rizika zbog širenja svojih farmi. Kada se uzme u obzir dobijena ocena rizika, očigledno je koliko je malo mera biosigurnosti uopšte usvojeno, pošto su dobijeni nivoi rizika bili visoki i srednje visoki.

Mere biosigurnosti se identifikuju na osnovu puteva prenošenja zaraznih bolesti i faktora rizika (23). Neke od njih su specifične za bolest (npr. protokoli vakcinacije), ali većina mera biosigurnostije generička i doprinosi smanjenju rizika povezanih sa nekoliko zaraznih bolesti, bilo sprečavanjem njihovog unošenja (npr. primenom karantina), blokiranjem puteva prenosa (npr. izolacijom bolesnih životinja) ili smanjenjem ukupnog pritiska infekcije (npr. podizanjem nivoa opšte higijene).

Pravilnim postupanjem u okolini, na primer smanjenjem fekalne kontaminacije, smanjenjem prenaseljenosti ili eliminacijom nosilaca ili vektora patogena je moguće smanjiti verovatnoću pojave bolesti (20,30). To je moguće postići i selekcijom životinja otpornih na bolesti ili povećanjem otpornosti populacije kroz prirodne ili veštačkim sredstvima (15), a samim tim i uticaj bolesti. Pored toga, informacije o određenim faktorima domaćina, kao što su starost i pol, usko povezani sa mnogim bolestima, korisne su za predviđanje infekcija unutar populacije ili grupe životinja i pomažu u prilagođavanju i primeni programa kontrole bolesti.

Oliveira i sar (31) su ukazali na nedovoljno usvajanje biosigurnosti u 16 danskih mlečnih stada, što predstavlja rizik po zdravlje životinja i ljudi, pored ugrožene produktivnosti i dobrobiti životinja. Odgajivačma su poznate priznate biosigurnosti prakse za sprečavanje unošenja i širenja zaraznih

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bolesti u stadima, npr. održavanje statusa zatvorenog stada i rutine kako bi se obezbedila poboljšana higijena pri rukovanju životinjama iu objektima. Međutim, postoje odgajivači koji izražavaju opuštene stavove o biosigurnosti u situacijama kao što su lokacija stada u regionu koji je navodno manje ugrožen od bolesti, potreba za povećanjem veličine stada i vrednosti koje se odnose na održavanje sistema poljoprivrede bez preteranih ograničenja. Ostala moguća ograničenja za pravilno usvajanje biosigurnosti uključivala su otežanu komunikaciju između farmera i njihovih zaposlenih i posetilaca, nedostatak znanja o putevima širenja infekcije i finansijska ograničenja. Poljoprivrednici su informacije o biosigurnosti dobijali iz više izvora, a veterinari se smatraju glavnim i pouzdanim. Pozitivni stavovi o zakonodavstvu su se pojavili kao način da se garantuje uzajamno usvajanje biosigurnosti među poljoprivrednicima, dok su drugi verovali da zakon možda neće biti potreban. Nalazi ove studije su pokazali da su, generalno, poljoprivrednici prepoznali važne aspekte biološke bezbednosti.

Studija model Leverin i sar. (14) je pokazao da su najvažniji faktori koji utiču na rizik i uticaj biosigurnosnih mera kao što su karantin i nošenje zaštitne, odeće učestalost kontakta između farmi i prevalencija bolesti. Rizik od unošenja i efekat biosigurnosnih mera varirao je u zavisnosti od vrste farme i puta prenosa bolesti. Model procene rizika se pokazao korisnim za ilustraciju rizika od unošenja endemske bolesti i ublažavajući efekat različitih mera biosigurnosti na nivou farme. Rezultati modela bi se mogli koristiti da opravdaju i pomognu veterinarskim savetnicima da razumeju rizike specifične za farmu i motivišu farmere da poboljšaju biosigurnost na svojoj farmi, jer se može prilagoditi potrebama i preferencijama svakog farmera.

Biocheck Cattle alat koji je razvio Damiaans i sar. (13) se zasniva na faktorima rizika i merama biosigurnosti u vezi sa prioritetnim bolestima goveda i rezultatima ankete preseka na belgijskim farmama sa odabranim pitanjima. Sistem bodovanja se sastoji od tri odvojena upitnika koji sadrže 69 (tov teladi), 104 (tov junadi) i 124 (proizvodnja mleka) pitanja. Stručnjaci iz različitih oblasti veterinarske medicine zamoljeni su da odmere različite kategorije biosigurnosti i pitanja prema Goreovom metodu. Dobijeni sistem obezbeđuje bodove biosigurnosti po kategoriji (spoljna i unutrašnja biosigurnost) i podkategorijama (npr. nabavka, transport, zdravstveni menadžment). Biocheck alat je zatim korišćen u istraživanju za procenu nivoa biosigurnosti na 20 farmi za tov teladi, 50 farmi za tov junadi i 50 farmi za proizvodnju mleka.I unutrašnja i eksterna biosigurnost su kategorisane kao niske za sve proizvodne sisteme, sa niskim prosečnim ukupnim ocenama biosigurnosti od 39,7 poena za tov teladi (SD = 7,4), 44,3 za tov junadi (SD = 8,4) i 48,6 poena za farme muznih krava (SD = 8,1) od maksimalnih 100 poena. Rezultati za unutrašnju biosigurnost bili su niži nego za eksternu biosigurnost za sve tipove farmi. Farme za tov junadi su imale znatno niže rezultate za uvođenjenovih grla od farmi tovnih goveda i farmi muznih krava, dok su za ostale potkategorije eksterne biosigurnost i dobile veći rezultat. Za farme muznih krava i tov goveda nabavka i reprodukcija su najviše ocenjene. Za internu biosigurnost, upravljanje zdravljem je bilo posebno nisko u tri tipa farmi, farme sa više od 50 poena bile retke. Ovi rezultati dokazuju da se ovaj alat može koristiti za procenu primene biosigurnost i na farmama goveda na standardizovan i ponovljiv način. Ovo će omogućiti kategorizaciju farmi i kvalitetno savetovanje za svako stado ponaosob.

Studija Renault i sar. (16) je prikazala glavne nalaze različitih studija sprovedenih od 2015. do 2021. godine kako bi se analizirao nivo biosigurnosti na belgijskim farmama goveda, uključujući stavove i ponašanja stočara i veterinara farmi u vezi sa merama biološke bezbednosti. Konkretno, cilj je bio da se izvrši SWOT analiza (snage, slabosti, prilike i pretnje) situacije i da se predloži novi konceptualni okvir za poboljšanje nivoa biosigurnosti u sektoru stočarstva. Nivo primene biosigurnosnih u stočarstvu je još uvek relativno nizak i suočava se sa brojnim izazovima.

Podizanje nivoa biosigurnosti stočarske proizvodnje zahteva da se različite zainteresovane strane dogovore oko zajedničkih ciljeva i pažljivo razmotre zdravlje životinja, ljudi i životne sredine, kao i društveno-ekonomske i kulturne faktore. Potrebne su dalje studije isplativosti da bi se identifikovale najvažnije mere biološke bezbednosti i da bi se zainteresovane strane uverile u njihove prednosti i prednosti. Stočari se uglavnom oslanjaju na veterinare sa kojma sarađuju za tehničke savete i smatraju ih pouzdanim izvorima informacija. Da bi efikasnije promovisali ove dobre prakse, ruralnim veterinarima su potrebne adekvatne smernice od strane vlasti, odgovarajuća obuka o biološkoj bezbednosti i komunikaciji i povoljno okruženje. Ipak, iako mnoge od ovih studija savetuju upotrebu

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preventivnih procedura, one često ne pružaju dokaze o efikasnosti ili isplativosti angažovanja u takvim praksama (3). Značajne razlike u preporukama u publikacijama mogu dovesti do zabune među poljoprivrednicima, što rezultira usvajanjem manje odgovarajućih praksi, koje su „poželjne“ ili jednostavne za implementaciju, ali ne nužno i najefikasnije za farmu o kojoj je reč (32). Rutinski postupci biosigurnosnih mera na nivou stada mogu smanjiti verovatnoću unošenja bolesti u stado, ali se neke mere mogu smatrati skupim i glomaznim za farmere (14). Mere napravljene po meri zasnovane na individualnim karakteristikama farme mogu pomoći u poboljšanju stvarne primene biobezbednosti na farmi (6,7). Više aspekata, od kojih je jedan percepcija efikasnosti ovih praksi, utiče na usvajanje preventivnog ponašanja, čime se ograničava usvajanje praksi biosigurnosti na farmama mleka širom sveta.

Prema Herrmannu i sar. (33), sprovođenje aktivnosti upravljanja na farmama za tov i proizvodnju mleka u Nemačkoj zavisi kako od stava ljudi koji obavljaju posao, tako i od njihovog razumevanja zašto posao treba da se obavlja. U kontekstu stočarstva, primena takvih praksi je ključna za funkcionalnost biosigurnosti. Ovi autori su sproveli anonimnu onlajn anketu nemačkih farmera i zaključili da su, generalno, farmeri svesni značaja biosigurnosti i da su shodno tome imali koncepte biosigurnosti farme, koji se odražavaju u sadašnjem evropskom zakonodavstvu, budući da su „operateri farmi odgovorni za minimiziranje rizik od širenja bolesti”. S druge strane, svest o putevima unošenja bolesti životinja na farmu bila je povezana sa nedostatkom znanja o tome kako unaprediti mere u ovim oblastima. Ovo potvrđuje ulogu veterinara u kontekstu biosigurnosti. Sve u svemu, visok nivo posvećenosti farmera ukazuje na dobru primenu svakodnevnih praksi.

Studija Denis-Robichaud i sar. (34) o opštem razumevanju biosigurnosti i percepciji delotvornosti specifičnih praksi biosigurnosti (njih 17) sprovedeno je 2015. sa 368 kanadskih farmera. To je uključivalo korelacije između percepcije efikasnosti svake prakse biosigurnosti i njene primene na farmi. Većina ispitanika smatra da je svrha biosigurnosti na farmi da spreči i uvođenje novog patogena i širenje postojećeg patogena (73%) i smatra da je opšta biološka bezbednost efikasna (92%) i važna (58%). Poljoprivrednici smatraju da je većina mera biološke bezbednosti delotvorna (60–94%). Više ispitanika je smatralo da su prakse koje se odnose na direktan kontakt životinja-životinja efikasnije nego prakse biološke bezbednosti koje se odnose na zarazu i posetioce. Manje od 20% njih izjavilo je da su razgovarali o različitim praksama biosigurnosti sa veterinarom, a manje od 60% je izjavilo da koristi ove prakse na svojoj farmi. Konačno, razlozi koje je većina farmera navela za primenu mera biosigurnosti bili su da (1) ta mera pomaže u sprečavanju unošenja ili širenja bolesti na regionalnom nivou i (2) da se pokazalo da koristi zdravlju i dobrobiti životinja. Ovi rezultati ukazuju na to da se efikasnost određenih biobezbednosnih praksi doživljava pozitivno; može postojati nedostatak razumevanja praksi koje utiču na prenošenje bolesti putem indirektnog kontakta i da je uočena pretnja nesprovođenja praksi minimalna.

On-line istraživanje Renault i sar. (11) je sprovedeno u Belgiji, Francuskoj i Španiji kako bi se procenilo ponašanje seoskih veterinara prema biološkoj bezbednosti i nivo implementacije mera biobezbednosti. Studija je identifikovala različite prednosti, slabosti, moguća ograničenja i rešenja u pogledu veterinarskih perspektiva. Veterinari se smatraju ključnim izvorima informacija od strane farmera, tako da bi trebali biti aktivniji u smislu vođenja i poboljšanja biosigurnosti na nivou farme. Činilo se da su dva faktora značajno uticala na nivo implementacije mera: zemlja prakse i nivo percepcije veterinara o biološkoj bezbednosti. Faze biosigurnosti sa najnižim nivoom primene, samim tim i najvećim rizikom bile su bio-isključenje, povećavajući rizik od unošenja bolesti, i bio-sadržaj, povećavajući rizik od transmisije među stadom. Na osnovu ove analize, početna lista bolesti zahteva hitnu pažnju u ovom delu Evrope, jer su sve zoonoze: hemoragična groznica Krimskog Konga, bolest virusa ebole, Marburg hemoragična groznica, Lasa groznica, bliskoistočni respiratorni sindrom (MERS), teški akutni respiratorni sindrom (SARS), bolest virusa Nipah i groznica doline Rift.

Infrastruktura biosigurnosti (npr. područja za teljenje, izolaciona staja) retko je dostupna na farmama. Glavne slabosti koje bi trebalo ispraviti su vezane za bio-isključenje i bio-zadržavanje, a to su tuševi i prostorije za sanitaciju za posetioce, karantin za novonabavljena grla, kontrola posetilaca i kontakti sa drugim domaćim vrstama i divljim životinjama. Što se tiče veterinarske prakse, trenutni nivo implementacije je prilično nizak, tako da postoji veliki prostor za poboljšanje, na primer, organizovanje poseta na osnovu rizika od kontaminacije (16).

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Koristeći modifikovanu Delphi metodu, Kuster i sar. (17) su potražili od 8 švajcarskih veterinarskih specijalista da rangiraju mere biosigurnosti tako što će dodeliti ocenu od 0 (najniži) do 5 (najviši) na osnovu njihovog značaja u vezi sa švajcarskim zakonodavstvom, izvodljivosti, kao i napora potrebnih za implementaciju i koristi od svaka mera biološke bezbednosti. Biosigurnosne mere su rangirane na osnovu njihove efikasnosti u sprečavanju ulaska infektivnog agensa i širenja na farmi, isključivo na osnovu karakteristika prenosa specifičnih patogena: bolesti plavog jezika, goveđe virusne dijareje, slinavke i šapa i infektivnog goveđeg rinotraheitisa. Za farme goveda, biosigurnosne mere koje podižu svest farmera o bolestima su rangirane kao najvažnije i najefikasnije. Među svim evaluiranim pojedinačnim merama, edukacija farmera stručnjaci su ocenili kao najvažniju i najefikasniju za zaštitu švajcarskih govedarskih farmi od bolesti. Autori su identifikovali razliku između pojmova „važnost" i „efikasnost" biobezbednosnih mera, zahtevajući dalja istraživanja o efikasnosti mera biobezbednosti. Oni skreću pažnju na potrebu za preciznijim i opšteprihvaćenim definicijama biosigurnosnih mera, koje bi olakšale komunikaciju sa farmerima i kreatorima politike o značaju biosigurnosti na farmi. Nalazi ove studije predstavljaju važnu osnovu za preporuku poljoprivrednicima i kreatorima politike. Švajcarskim pristupom održavanju populacije stoke bez bolesti uglavnom dominiraju vladine mere kontrole, uz obaveznu vakcinaciju protiv bolesti plavog jezika 2008–2010. i tekući program iskorenjivanja dijareje goveđeg virusa (35,36). Nasuprot tome, primena biobezbednosnih mera na farmi u Švajcarskoj je relativno loša, što se može povezati sa činjenicom da su švajcarska stada, uprkos globalnom trendu povećanja, i dalje relativno mala.

Nöremark i Sternberg-Leverin (37) su istraživali percepciju profesionalaca koji posećuju farme u Švedskoj o farmskoj biosigurnosti, faktorima koji utiču na njihove biosigurnosne rutine i šta oni opisuju kao prepreke za biobezbednost, kao i predloge za poboljšanje. U svim grupama, većina od 386 ispitanika uočila je prepreke za biosigurnost na farmi, među veterinarima 66% je smatralo da postoje prepreke, uglavnom vezane za sam osnovni nivo biosigurnosti, kao što je pristup sapunu i vodi. Odgovornost je identifikovana kao ključno pitanje; dok neki farmeri očekuju da posetioci preuzmu odgovornost za održavanje biosigurnost, oni ne obezbeđuju adekvatne uslove na farmi. Posetioci treba da preuzmu odgovornost za izbegavanje širenja bolesti, dok farmeri treba da preuzmu odgovornost za obezbeđivanje adekvatnih uslova za biosigurnost na farmi.

Toma i sar. (38) su uradili telefonsku anketu o uticaju determinanti biobezbednosnog ponašanja 900 farmera goveda i ovaca u Velikoj Britaniji i ustanovili da farmeri prihvataju značaj specifičnih strategija biosigurnosti, organske sertifikacije farme, poznavanje mera biološke bezbednosti, stavova prema dobrobiti životinja, uočenu korist od izvora informacija o biološkoj bezbednosti, uočeni uticaj izbijanja teških bolesti životinja na farmama u poslednjih pet godina, članstvo u programima zaštite zdravlja goveda/ovaca, stavovi prema biosigurnosti u stočarstvu, uticaj na odluku o primeni biosigurnosnih mera, iskustvo i ekonomski faktori značajno utiču na ponašanje (objašnjavajući 64% varijanse u ponašanju ukupno).

Brojne studije su pokazale da farmeri donose različite upravljačke odluke u različitim fazama svog života. Mlađi farmeri sa velikim stadima i malo izdržavanih porodica spremniji su da učestvuju u programu iskorenjivanja, dok su stariji farmeri bez potomstva manje spremni da promene svoje sisteme upravljanja (39). Obrazovanje, iskustvo i kognitivne sposobnosti su varijable koje imaju značajan uticaj na proces donošenja odluka i često su povezane sa godinama donosioca odluka. Pored toga, pokazalo se da obrazovanje i obuka poboljšavaju i utiču na spremnost farmera da sprovedu promenu u praksi upravljanja (40). Poljoprivrednici koji su iskusili izbijanje bolesti u prošlosti će verovatnije koristiti izvore informacija i primenjivati više mera biološke bezbednosti trenutno na svojim farmama. Pored toga, farmeri koji su članovi programa zdravstvene zaštite goveda i ovaca verovatno će primeniti više mera biološke bezbednosti na svojim farmama.

Mala porodična gazdinstva igraju važnu ulogu u razvoju ruralne ekonomije, smanjujući siromaštvo među poljoprivrednicima, posebno u zemljama u razvoju. Međutim, ova kategorija proizvođača se tokom poslednje decenije suočila sa brojnim finansijskim, tehničkim i pravnim izazovima (41).

Prema Canu i Altugu (25), biosigurnost igra ključnu ulogu u sprečavanju zaraznih bolesti i povećanju produktivnosti farme. Oni su sproveli na ukupno 50 malih farmi muznih krava u Hataju u Turskoj, kako bi utvrdili tehničke i ekonomske rezultate farmi i ispitali povezanost između praksi biosigurnosti i socioekonomskih karakteristika proizvođača,

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koristeći kontrolnu listu koja se odnosi na 19 biosigurnosti. prakse, koristeći tehničke i ekonomske sisteme bodovanja prisustva i cene svake od praksi biosigurnosti. Ustanovili su da su najčešće korišćeni tretmani bolesnih životinja (98%), vakcinacija protiv najčešćih zaraznih bolesti (90%) i upotreba kreča za staje (86%), dok su testiranja na najčešće zarazne bolesti pre kupovina (10%) je korišćena po najnižoj stopi.

Autori su pronašli značajne razlike među grupama u pogledu nivoa obrazovanja (<.05), dohodovne klase (<.05) i veličine stada (<.01). Rezultati biosigurnosti bili su u značajnoj pozitivnoj korelaciji sa veličinom stada (<.05) i nivoom obrazovanja proizvođača (<.01). Postojale su statistički značajne veze između socioekonomskih karakteristika proizvođača i nekih praksi biosigurnosti. Autori su zaključili da programi obuke treba da imaju za cilj da promene stavove i percepciju malih proizvođača o lošim praksama biološke bezbednosti. Kako bi podstakli proizvođače da povećaju rezultate biosigurnosti, propisi koji se odnose na finansijsku podršku i kazne mogli bi biti veoma korisni i na regionalnom i na nacionalnom nivou.

Analiza stanja biosigurnosti na farmama mleka, goveda i ovaca u Srbiji različitog kapaciteta u diplomskim radovima studenata zootehnike koju su uradili Hristov i Stanković tokom poslednje decenije otkriva mnogo problema. Nivo biosigurnosti je uglavnom dobar ili veoma dobar ili retko dovoljan (prosečne ocene farmi su bile u rasponu od 3,85 do 1,49). Postoji ozbiljan nedostatak obuke i shodno tome, prilično nizak nivo svesti o rizicima biološke bezbednosti. To ukazuje da odgajivači moraju biti upoznati sa modelima širenja patogena i ulaznim vratima u pojedinu životinju ili populaciju. Poljoprivrednici dosta dobro vode računa o opštem zdravlju životinja (npr. mastitis, poremećaji kandži, problemi sa varenjem itd.), ali izgleda da nisu svesni rizika od zaraznih bolesti. Kontrola posetilaca je prilično liberalna, što je opšta situacija u Srbiji. Neophodne procedure se mogu obavljati mnogo upornije i odgovornije, posebno tokom leta, kada poljski radovi oduzimaju mnogo vremena poljoprivrednicima. Biosigurnosne procedure moraju biti ozbiljnije i određene približavanjem objektu zaštite.

OGRANIČENJA I OGRANIČENJA IMPLEMENTACIJE BIOSIGURNOSNIH PROCEDURA

Istorijski gledano, uloge i odgovornosti vlade, industrije i vlasnika životinja u vezi sa kontrolom bolesti bile su zasnovane na nizu pretpostavki koje nisu uvek rezultirale zajedničkim radom glavnih aktera. Barel (42) je postavio pitanje: „Šta proizvođači mogu da urade da se zaštite od epidemija bolesti?“ navodeći da tu industrija očigledno ima glavnu ulogu. Jedan od mogućih odgovora bio je rast nezavisnih inicijativa za biosigurnost među motivisanim farmerima ovaca i goveda i između farmera i njihovih veterinarskih savetnika u nekoliko regiona UK (1).

Toma i sar. (38) su zaključili da što je jači stav farmera prema biosigurnosti, veća je verovatnoća da će primeniti mere biosigurnosti na svojim farmama (naime da su mere biosigurnosti od suštinskog značaja za održavanje zdravog stada, da bi primena mera biosigurnosti mogla mnogo da uštedi poljoprivrednike novca i da su propisi o biosigurnosti dobri za zdravlje životinja). Ogromna većina veterinara smatra da je biosigurnost prioritet njihove profesije, iako ne smatraju da je njihova bezbednost ugrožena u svakodnevnoj praksi. Ovo bi moglo predstavljati pretnju po javno zdravlje pošto je seroprevalencija zoonoza znatno veća među veterinarima u ruralnim područjima (43). Anketa je istakla slabosti i oblasti za poboljšanje, posebno u vezi sa bio-isključivanjem (u vezi sa rizikom od unošenja bolesti) i biološkim zadržavanjem (u odnosu na rizik od prenošenja bolesti između stada). U slučaju da ne usvoje dobru praksu, veterinari bi mogli biti neuspešni u jednoj od svojih glavnih obaveza, da ograniče širenje bolesti u slučaju izbijanja, i da predstavljaju visok rizik za farmere jatrogenim putem prenošenja bolesti u prostorijama. Iako su veterinari izrazili različita ograničenja, moguća rešenja postoje i već su ih primenili neki veterinari, kao što je autonomni i mobilni sistem za dekontaminaciju ili odeća, čizme i/ili kutije za hirurški materijal namenjen farmi koje se ostavljaju u prostorijama.

Nedostatak finansijskih sredstava može biti važan faktor za male i srednje farmeree da (ne)usvoje određene mere biosigurnosti (44). Jednostavne i isplative mere biološke bezbednosti mogu se lako primeniti, uključujući informisanje posetilaca o ograničenjima pristupa, pravilno postupanje sa životinjama i obezbeđivanje da posetioci dezinfikuju ruke i obuću pre nego što uđu u objekte za uzgoj goveda. Pored toga, neophodno je imati određeni parking prostor za vozila i to treba naglasiti. Postupci čišćenja i dezinfekcije su od suštinskog

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značaja za sprečavanje širenja patogena, a posebno je potrebno očistiti i dezinfikovati sva vozila koja redovno ulaze u posed. Svakodnevno čišćenje i dezinfekcija kamiona zajedničkih za prevoz životinja su od ključne važnosti, iako ove mere mogu zahtevati značajna finansijska ulaganja ili rad zaposlenih da bi se te mere sprovele (24).

Slika 2. Predloženi konceptualni model koji objašnjava faktore koji utiču na sprovođenje mera biosigurnost i na belgijskim farmama goveda. U narandžastim poljima su dati faktori negativnog dejstva; u zelenim poljima su dati faktori pozitivnog dejstva (11) – pogledati englesku verziju rada

Renault i sar. (11) su istakli da nekoliko faktora mogu negativno uticati na sprovođenje mera biosigurnosti na farmama goveda. One se odnose i na stavove i svest farmera i na administrativne i pravne okolnosti. Na osnovu ovoga, može se dati nekoliko preporuka u cilju poboljšanja nivoa biosigurnosti na farmama goveda, kao što se može zaključiti na slici 2. Autori su istakli da postoji neodložna potreba za studijama troškovne efikasnosti zasnovanim na dokazima kako bi se identifikovala prioritetne mere biološke bezbednosti i dokazati poljoprivrednicima njihovu ekonomsku efikasnost (28). Prethodno je pomenuto da nivo percepcije veterinara o merama biosigurnosti značajno utiče na adekvatnu primenu dobrih praksi. Stoga je od suštinske važnosti dati biološkoj bezbednosti veću ulogu u programima veterinarske obuke i nastavnom planu i programu, i obezbediti odgovarajuću i progresivnu svest koja se pojavljuje kao deo kontinuirane edukacije koja se predlaže veterinarima (11).

Identifikovane mere moraju biti relevantne, adekvatne i izvodljive za potrebe farmera. Treba ih podeliti sa drugim zainteresovanim stranama kako bi se izbegle moguće kontradikcije (npr. uklanjanje elemenata „zelenog pojasa" koji okružuje farmu: grmlja i vegetacije radi kontrole vektora, dok ekološka politika promoviše prirodne žive ograde i sprečava uklanjanje vegetacije). Što se tiče pristupa prema konceptu jednog zdravlja, mere biosigurnosti treba smatrati sveobuhvatnim, kao „jedinstveni koncept za integraciju zdravlja ljudi, životinja, biljaka i životne sredine" (45). Negativan uticaj nekih preventivnih tretmana na životnu sredinu ili zdravlje ljudi je dokumentovan u prošlosti, na primer razvoj (multi)rezistencije na lekove u vezi sa preventivnom upotrebom antibiotika u nekom sistemu intenzivnog uzgoja (46), kontaminacija životne sredine u vezi sa tretmanom životinja akaricidima (47) i negativnim efektima na korisne insekte posle upotrebe hemijskih larvicida u kontroli mesta za razmnožavanje vektora (48). Negativne posledice bi se mogle izbeći primenom pristupa Jednog zdravlja, povezujući oblasti zdravstva, poljoprivrede i zaštite životne sredine. Uzimanje u obzir prirodnih i društvenih nauka može olakšati prihvatanje mera biosigurnost i od strane stanovništva (44). Ovi aspekti su jasno uzeti u obzir Evropskim zelenim dogovorom (49), čije oblasti politike uključuju, između ostalog, biodiverzitet (mere za zaštitu ekosistema) i bezbednost hrane. Pored toga, efikasna obuka fokusirana na izabrane ciljeve i komunikacija sa farmerima bi se idealno trebalo odvijati od strane renomiranih izvora kao što su veterinari ili udruženja farmera, kako bi se promovisala biosigurnost i glavne mere biosigurnosti, znanje i svest zainteresovanih strana i pouzdano zakonodavstvo. Na kraju, ali ne i najmanje važno, dalje studije bi trebalo da pribave ubedljive dokaze o isplativosti mera biološke bezbednosti i da preporuče prioritetne mere za njihovu korisnost i koristi (16).

Uspešna primena preporučenih praksi upravljanja povezana je sa percepcijom rizika od strane farmera, uključujući prihvatljiv rizik i povezane posledice, kao i značaj određene mere biološke bezbednosti (11). Stoga, uočena efikasnost preporučenih smernica, izvodljivost i tehničko znanje o ovoj temi povećavaju verovatnoću usvajanja mera biosigurnosti u proizvodnim sistemima (24). Prema Oliveira-i i sar. (31), ukazano je na nedovoljno usvajanje biosigurnosti u mlečnim stadima. Ovo stvara stvarne rizike po zdravlje životinja i ljudi, osim što izaziva zabrinutost zbog ugrožene produktivnosti i dobrobiti životinja. Ipak, generalno, farmeri su upoznati sa važnim aspektima biološke bezbednosti. Uprkos tome, prisutni su faktori koji ograničavaju donošenje mera biosigurnost i.

ZAKLJUČCI

Opšta ocena sprovođenja mera biosigurnost i na farmama preživara širom sveta je da bi to moglo da se uradi mnogo bolje.

Iako je evidentno da svi učesnici u proizvodnji shvataju da imaju važnu ulogu u zdravlju stada i zaštiti proizvodnje od uzročnika patogena i izbijanja bolesti, njihovo znanje o procedurama i merama

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koje se moraju preduzeti često je veoma ograničeno. Postoji ozbiljan nedostatak obuke i shodno tome, prilično nizak nivo svesti o rizicima biološke bezbednosti. Poljoprivrednici su svesni neophodnosti dobrog zdravlja životinja, ali uglavnom misle na endemične bolesti poput mastitisa, poremećaja kandži, problema sa varenjem itd.); izgleda da nisu svesni rizika od zaraznih bolesti. To ukazuje da moraju biti upoznati sa modelima širenja patogena i ulaznim vratima u pojedinu životinju ili populaciju.

Mišljenje farmera je da bi vlada trebalo da ima veći doprinos u biosigurnost i; veterinari su kao glavnu prepreku videli sposobnost ili spremnost svojih klijenata da ulažu u mere biosigurnost i. Dodatni dokazi o efikasnosti i/ili potencijalnim ekonomskim koristima predloženih mera biološke bezbednosti na farmi treba da budu bolje prikazani. To bi dalo solidnu osnovu terenskim veterinarima i njihovim organizacijama da budu proaktivniji u promociji i širenju informacija o biosigurnost i, kako u direktnom kontaktu sa farmerima, tako iu organizovanoj obuci. Ovu važnu ulogu treba ostvariti u saradnji sa udruženjima poljoprivrednika i veterinarskim vlastima. Pravni okvir može biti od pomoći, kao i podsticajne mere za one koji aktivno i uspešno prihvataju koncept biosigurnost i u svom radu.

U mnogim slučajevima postoje problemi u vezi sa primenom procedura biosigurnosti, posebno u kontroli kretanja ljudi, životinja, vozila i opreme. Postupci se moraju izvoditi mnogo upornije i odgovornije, posebno tokom leta, kada poljski radovi oduzimaju mnogo vremena poljoprivrednicima. Biosigurnosne procedure moraju biti ozbiljnije i odlučnije primenjivane kao približavanje objektu zaštite.

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LITERATURA

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