

PROCEEDINGS
26TH INTERNATIONAL CONGRESS OF THE
MEDITERRANEAN FEDERATION FOR HEALTH AND
PRODUCTION OF RUMINANTS
FeMeSPRum

Novi Sad (Serbia), 20th – 23rd June, 2024

ZBORNİK RADOVA
26. MEĐUNARODNI KONGRES MEDITERANSKE
FEDERACIJE ZA ZDRAVLJE I PRODUKCIJU
PREŽIVARA
FeMeSPRum

Novi Sad (Srbija), 20. – 23.jun 2024.godine



PROCEEDINGS
26TH INTERNATIONAL CONGRESS OF THE
MEDITERRANEAN FEDERATION FOR HEALTH AND
PRODUCTION OF RUMINANTS
FeMeSPRum

Novi Sad (Serbia), 20th – 23rd June, 2024

ZBORNİK RADOVA
26. MEĐUNARODNI KONGRES MEDITERANSKE
FEDERACIJE ZA ZDRAVLJE I PRODUKCIJU
PREŽIVARA
FeMeSPRum

Novi Sad (Srbija), 20. – 23.jun 2024.godine

CIP - Каталогизација у публикацији
Библиотеке Матице српске, Нови Сад

636.2/.3(082)
636.082.4(082)
636:619(082)

INTERNATIONAL Congress of the Mediterranean Federation for Health and Production of Ruminants FeMeSPRum (26 ; 2024 ; Novi Sad)

Proceedings = Zbornik radova / 26th International Congress of the Mediterranean Federation for Health and Production of Ruminants FeMeSPRum, Novi Sad, 20th-23rd June, 2024 = 26. Međunarodni kongres mediteranske federacije za zdravlje i produkciju preživara FeMeSPRum, Novi Sad, 20.-23.jun 2024.godine ; [Editors-in-chief of proceedings Jože Starič and Marko Cincović]. - Novi Sad : Poljoprivredni fakultet, Departman za veterinarsku medicinu, 2024 (Beograd : Birograf). - XVI, 348 str. : ilustr. ; 30 cm

Radovi na srp. i engl. jeziku. - Tiraž 300. - Bibliografija uz svaki rad. - Rezime na srp. i engl. jeziku uz svaki rad.

ISBN 978-86-7520-611-8

a) Преживари -- Здравствена заштита -- Зборници b) Преживари -- Репродукција -- Зборници

COBISS.SR-ID 146477577

Dear Participants of the FeMeSPRum Congress,

Welcome to the 26th Congress of the Mediterranean Federation for Health and Production of Ruminants (FeMeSPRum). It is an honor to gather with you esteemed veterinarians and animal scientists dedicated to advancing the health and productivity of ruminants in the Mediterranean region.

This year's Congress is in the beautiful city of Novi Sad, Serbia. Nestled on the banks of the Danube River, Novi Sad is renowned for its vibrant culture, rich history, and stunning architecture. Known as the "Serbian Athens," it is home to the majestic Petrovaradin Fortress, numerous museums, galleries, and the lively Danube Park. As the European Capital of Culture for 2022, Novi Sad offers a perfect blend of tradition and modernity, providing a picturesque and inspiring backdrop for our meeting.

This year's Congress will focus on critical topics that directly impact the health, production, and welfare of the animals we care for. Topics include Biosecurity and heat stress on ruminant farms, Parasite control in ruminants, and Clinical pathology and healthcare of ruminants. These scientific sessions will provide cutting-edge insights and innovative solutions, besides fostering collaboration and the exchange of expertise among leading professionals from the region.

The Mediterranean region has a unique climate, geography, and agricultural practices that present specific challenges and opportunities for ruminant health and production. Advancing the health of domestic ruminants in this region is crucial for ensuring sustainable agriculture, enhancing food security, and supporting the livelihoods of countless farmers and communities. Your work and dedication play a vital role in addressing these challenges and promoting the well-being of domestic ruminant populations.

The Mediterranean Federation for Health and Production of Ruminants (FeMeSPRum) is an organization with immense potential. Its core idea is to serve as a medium for fruitful collaboration among stakeholders in ruminant production. This platform is not only for exchanging information and good practices but also aims to provide a consortium that can cooperate in writing international project proposals and succeed in international project calls. By working together, we can be more innovative and have an impact in our field. With this in mind, I am sure this Congress will boost this idea and strengthen our Federation.

All this would not be possible without the dedicated organizing committee and especially Prof. Dr. Marko Cincović, president of the organizing committee, who have done their best to prepare everything for a smooth congress. Your hard work and dedication are deeply appreciated. Additionally, thank you to all our sponsors, whose generous support has made this event possible.

Your participation and contributions to the Congress are not only crucial to the success of this Congress but also to the existence of the Federation. Together, we will explore new strategies, share best practices, and pave the way for significant advancements in ruminant health and production.

Thank you for being here, and I look forward to a productive and inspiring congress in the charming city of Novi Sad.

With best wishes,

Prof. Dr. Jože Starič

President of the Mediterranean Federation for Health and Production of Ruminants (FeMeSPRum)

Drage kolegice i kolege,

Mediteranska federacija za zdravlje i proizvodnju preživara (FeMeSPRum) je međunarodno udruženje koje okuplja različite profesionalce iz akademske i istraživačke sfere (najčešće veterinare, ali i agronome, inženjere animalne proizvodnje i dr.) koji su posvećeni brizi o preživarama, proučavanju i prevenciji bolesti ovih životinja, kao i povećanju i poboljšaju njihove proizvodnje (meso, mleko, vuna, itd.), dobiti i svega onoga što će uticati na dobijanje kvalitetnog i zdravstveno bezbednog proizvoda za krajnjeg potrošača. FeMeSPRum promoviše organizovanje obuka, diskusija, seminara i konvencija, sa definisanom periodičnošću, i podržava sva dešavanja koja doprinose unapređenju ovog sektora i saradnji između zemalja članica, a njeni direktni korisnici su stručna lica iz oblasti veterinarske medicine ali i drugih srodnih oblasti. Kao što mu ime govori, sfera uticaja se proteže na nekoliko zemalja mediteranskog regiona, uključujući Italiju, Španiju, Grčku, Tursku, Sloveniju, Hrvatsku, Siriju, Egipat, Tunis, Maroko. Iako naziv federacije ukazuje na njenu geografsku pripadnost, u eri globalne razmene i unapređenog transfera znanja i pomeranja klimatskih pojaseva, FeMeSPRum je proširio svoje delovanje i na zemlje u okruženju, a posebno značajna zemlja za ovu organizaciju je Srbija. U Srbiji smo 2011.godine imali kongres u Beogradu, a ove 2024.godine kongres se održava u Novom Sadu koji, na naše zadovoljstvo, organizujemo zajedno sa dve partnerske respektabilne ustanove i to su Departman za veterinarsku medicinu Novi Sad i Udruženje veterinara praktičara Srbije.

Dobro došli!

Prof. dr Jože Starič


Predsednik Mediteranske federacije za zdravlje i produkciju preživara (FeMeSPRum)

Publisher: Faculty of Agriculture Novi Sad – Department of Veterinary medicine,
University of Novi Sad, Trg Dositeja Obradovića 8, 21000 Novi Sad
Izdavač: Poljoprivredni fakultet Novi Sad – Departman za veterinarsku medicinu,
Univerzitet u Novom Sadu, Trg Dositeja Obradovića 8, 21000 Novi Sad

**PROCEEDINGS 26TH INTERNATIONAL CONGRESS OF THE MEDITERRANEAN
FEDERATION FOR HEALTH AND PRODUCTION OF RUMINANTS
FeMeSPRum Novi Sad (Serbia), 20th – 23rd June, 2024**

**ZBORNİK RADOVA 26. MEĐUNARODNI KONGRES MEDITERANSKE
FEDERACIJE ZA ZDRAVLJE I PRODUKCIJU PREŽIVARA
FeMeSPRum Novi Sad (Srbija), 20. – 23.jun 2024.godine**

Editors-in-Chief of proceedings / Glavni i odgovorni urednici zbornika:
Prof.dr Jože Starič, Prof.dr Marko Cincović

 <https://doi.org/10.5937/FeMeSPRumNS24>

VETERINARY REVIEW / VETERINARSKI PREGLED

Editor-in-Chief of journal/Glavni i odgovorni urednik časopisa: Prof. dr Aleksandar Potkonjak
Deputy Editors/Zamenici urednika: Prof. dr Ivan Stančić i Prof. dr Mihajlo Erdeljan
Technical Editors /Tehnički urednici: Doc. dr Zoran Ružić i Doc. dr Ivan Galić
Secretary/Sekretar: Dr vet. Tijana Kukurić, asist.

Editorial Board / Uređivački odbor:

Prof. dr Dragica Stojanović, Srbija; Prof. dr Romana Turk, Hrvatska; Prof. dr Miodrag Radinović
Srbija; Prof. dr Bojan Toholj, Srbija; Prof. dr Marko Cincović, Srbija; Prof. dr Nikolina Novakov,
Srbija; Prof. dr Jože Starič, Slovenija; Prof. dr Ramiz Čutuk, BiH; Prof. dr Radojica Đoković, Srbija;
Doc. dr Jožica Ježek, Slovenija; Prof. dr Ozren Smolec, Hrvatska; Prof. dr Zdenko Kanački, Srbija;
Prof. dr Romeo Teodor Cristina, Rumunija; Prof. dr Bojan Blagojević, Srbija; Prof. dr Plamen
Trojačanec, Severna Makedonija; Prof. dr Slavča Hristov, Srbija; Prof. dr Senad Prašović, BiH;
Prof. dr Nenad Stojanac, Srbija; Prof. dr Ognjen Stevančević, Srbija; Doc.dr Bojana Blagojević, Srbija

President of the Publishing Council /Predsednik izdavačkog saveta:
Prof. dr Nedeljko Tica, dekan Poljoprivrednog fakulteta, dean of Faculty of Agriculture

Publishing council /Izdavački savet:

Prof. dr Nada Plavša, Prof. dr Ljubica Spasojević, Kosić Prof. dr Vesna Lalošević,
Prof. dr Slobodan Stojanović, Prof. dr Ivana Davidov, Prof. dr Božidar Savić,
Prof. dr Zorana Kovačević, Prof. dr Marija Pajić, Prof. dr Stanislav Simin, Doc. dr Jovan Spasojević,
Doc. dr Annamaria Galfi Vukomanović, Doc. dr Ljiljana Kuruca, Doc. dr Vuk Vračar

Predmet časopisa: Časopis objavljuje naučne i stručne radove iz oblasti veterinarske medicine i srodnih disciplina.

Jezik radova: Srpski (sa engleskim apstraktom) ili Engleski (sa srpskim sažetkom) po želji autora.

Periodičnost: Jedna sveska godišnje

Vrste radova: Originalni radovi, Pregledni radovi, Meta-analize, Radovi iz istorije veterinarske medicine, Radovi iz oblasti veterinarskog
obrazovanja, Prikaz slučaja, Prikaz tehničkih rešenja, Prikazi knjiga, Naučna kritika, Pisma uredništvu, Izveštaji sa seminara i drugih stručnih
dogadaja. Format: Časopis izlazi u štampanoj/elektronskoj formi i biće publikovan na sajtu Departmana za veterinarsku medicinu

Prijava radova na mejl: vetpregled@gmail.com

Subject of the Journal: The Journal publishes scientific and professional papers in the field of veterinary medicine and related disciplines.

Language: Serbian (with English abstract) or English (with Serbian abstract).

Periodicity: One No per year

Papers: original papers, review articles, meta – analysis, papers from the history of veterinary medicine, papers in the field of veterinary
education, case report, technical solutions, book, scientific polemic, letters to the Editor, reports from seminars and other professional events.

For m at: The journal is published in printed and electronic form and will be published on the website of the Department of Veterinary
Medicine.

Manuscript submission: vetpregled@gmail.com

CONGRESS ORGANIZERS / ORGANIZATORI KONGRESA

Mediterranean Federation for Health and Production of Ruminants / Mediteranska federacija za zdravlje i produkciju preživara (FeMeSPRum)

Faculty of Agriculture Novi Sad – Department of Veterinary Medicine / Poljoprivredni fakultet Novi Sad –Departman za veterinarsku medicinu

Associations of veterinary practitioners of Serbia / Udruženje veterinarara praktičara Srbije (UVPS)

COMMITTEES / ODBORI

Scientific committee/ Programski (naučni) odbor

Prof. Dr. Jože Starič, University of Ljubljana, Slovenia (president)
Doc. Dr. Jožica Ježek, University of Ljubljana, Slovenia
Prof. Dr. Vincenzo Carcangiu, University of Sassari, Italy
Prof. Dr. Vincenzo Cuteri, University of Camerino, Italy
Dr. Antonio Bosco, University of Naples Federico II, Italy
Dr. Joana Jacinto, Dip. ECBHM, University of Bern, Switzerland
Prof. Dr. Ramiro Jose Montana, University of Leon, Spain
Prof. Dr. Andre de Almeida, University of Lisbon, Portugal
Prof. Dr. Ozren Smolec, University of Zagreb, Croatia
Prof. Dr. Dimitar Nakov, University Goce Delcev, North Macedonia
Prof. Dr. Halil Selçuk Biricik, Afyon Kocatepe University, Turkiye
Prof. Dr. Dragica Stojanović, University of Novi Sad, Serbia
Dr. Jasna Prodanov Radulović, Scientific Veterinary institute Novi Sad, Serbia
Prof. Dr. Slavča Hristov, University of Beograd, Serbia
Prof. Dr. Branislav Stanković, University of Beograd, Serbia
Doc. Dr. Ljiljana Anđušić, University of Priština, Serbia
Prof. Dr. Radojica Đoković; University of Kragujevac, Serbia
Prof. Dr. Vladimir Kurćubić, University of Kragujevac, Serbia
Dr. Miloš Petrović, University of Kragujevac, Serbia

Organizing committee / Organizacioni odbor

Prof. dr Marko Cincović (president)	Dr vet. med.spec. Bojan Blond (vice president)
Prof. dr Ivan Stančić	Doc. dr Jovan Spasojević
Prof. dr Mihajlo Erdeljan	Doc. dr Mira Majkić
Prof. dr Bojan Toholj	Doc. dr Zoran Ružić
Prof. dr Alekandar Potkonjak	Doc. dr Ivan Galić
Prof. dr Božidar Savić	Dr Sandra Nikolić
Prof. dr Ognjen Stevančević	Asist. dr vet.med. Jovan Stanojević
Prof. dr Nenad Stojanac	Dr vet.med. Miloš Jovičić
Prof. dr Miodrag Radinović	Dr vet.med. Goran Đmura
Prof. dr Ivana Davidov	Dr vet.med. Saša Marković
Prof. dr Zdenko Kanački	Dr vet.med. Vladimir Čitaković
Prof.dr Miroslav Urošević	Dr vet.med. Zoran Knežević
Dr Maja Došenović Marinković	Dr Biljana Delić Vujanović
Dr Siniša Grubač	Asist.MSc. Aleksandar Čukić

Honorary Board / Počasni odbor

Dr Jelena Begović, *Minister of Science, Technological development and Innovation, Serbia / Ministarka nauke, tehnološkog razvoja i inovacija Srbije*

Prof.dr Branko Markoski, *Provincial Secretary for Higher Education and Scientific Research, Vojvodina / Pokrajinski sekretar za visoko obrazovanje i naučnoistraživačku delatnost Vojvodine*

Prof.dr Nedeljko Tica, *Dean of Faculty of Agriculture Novi Sad / Dekan Poljoprivrednog fakulteta Novi Sad*

Prof.dr Nenad Magazin, *Vice dean of Faculty of Agriculture Novi Sad / Prodekan Poljoprivrednog fakulteta Novi Sad*

Prof.dr Mirjana Đukić Stojčić, *Vice dean of Faculty of Agriculture Novi Sad / Prodekan Poljoprivrednog fakulteta Novi Sad*

Prof.dr Branko Ćupina, *Vice dean of Faculty of Agriculture Novi Sad / Prodekan Poljoprivrednog fakulteta Novi Sad*

Dr vet.spec. Mišo Kolarević, *President of veterinary chamber of Serbia / Predsednik Veterinarske komore Srbije*

Dr vet.med. Velibor Kesić, *President of veterinary chamber of R.Srpska / Predsednik veterinarske komore R.Srpske*

Dr vet.med. Saša Bošković, *Director of Veterinary office of Bosnia and Hercegovina / Direktor Kancelarije za veterinarstvo BiH*

Dr vet.med. Ranko Savić, *President of Veterinary chamber Montenegro / Predsednik Veterinarske komore Crne Gore*

Dr vet.med. Žarko Mihajlovski, *President of Veterinary chamber of North Macedonia / Predsednik Veterinarske komore Severne Makedonije*

Dr vet.med. Tomislav Nikolovski, *Executive director of Veterinary chamber of North Macedonia / Izvršni direktor Veterinarske komore Severne Makedonije*

POKROVITELJI KONGRESA / SUPPORTED BY

Ministry of Science, Technological development and Innovation / Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije

Provincial Secretariat for Higher Education and Scientific Research / Pokrajinski sekretarijat za visoko obrazovanje i naučnoistraživačku delatnost Vojvodine

Veterinary chamber of Serbia / Veterinarska komora Srbije

SPONSORS OF CONGRESS / SPONZORI KONGRESA

General sponsor / Generalni sponsor:
ProMedia

Sponsors – friends of UVPS / Sponzori – prijatelji UVPS:

Pro feed – 2013, Superlab, Ave&Vetmedic, Biochem Balkan, Žarvel, Velvet animal health, ProMedia, Boehringer Ingelheim Serbia, Centralfarm, Dr Vet Group, Elanco, First-vet, HiraVet, Interagrar, InterPet Vet, IQ Vet, M&J Trade, Patent Co., SVC „Velika Plana“, UBM feed, Unconditional, Vestratek, Veterinarski zavod Subotica, VetMarket, VetPro, Effecta feed, West Chemie Vestal



Република Србија
МИНИСТАРСТВО НАУКЕ,
ТЕХНОЛОШКОГ РАЗВОЈА И ИНОВАЦИЈА



РЕПУБЛИКА СРБИЈА
АУТОНОМНА ПОКРАЈИНА ВОЈВОДИНА
ПОКРАЈИНСКИ СЕКРЕТАРИЈАТ ЗА ВИСОКО ОБРАЗОВАЊЕ
И НАУЧНОИСТРАЖИВАЧКУ ДЕЛАТНОСТ



ВЕТЕРИНАРСКА КОМОРА СРБИЈЕ



PROMEDIA
Laboratory supply specialists

BIOSECURITY MEASURES ON RUMINANT FARMS

BIOSIGURNOSNE MERE NA FARMAMA PREŽIVARA

Slavča Hristov^{a*}, Branislav Stanković^a, Jože Starič^b, Dimitar Nakov^c, Jasna Prodanov-Radulović^d,
Bojan Milovanović^e, Ilias Chantziaras^f, Alberto Allepuz^g

^aUniversity of Belgrade - Faculty of Agriculture, Belgrade-Zemun, Republic of Serbia

^bUniversity of Ljubljana, Veterinary Faculty, Ljubljana, Slovenia

^cFaculty of Agriculture, Goce Delcev University – Stip, Stip, Republic of North Macedonia

^dScientific Veterinary Institute “Novi Sad”, Novi Sad, Republic of Serbia,

^eInstitute of Veterinary Medicine of Serbia, Belgrade, Republic of Serbia

^fVeterinary Epidemiology Unit, Faculty of Veterinary Medicine, Ghent University, Belgium

^gDepartment of Animal Health and Anatomy, Universitat Autònoma de Barcelona, Spain

*Corresponding author: hristovs@agrif.bg.ac.rs



S.H. <https://orcid.org/0000-0002-1719-9971>, B.S. <https://orcid.org/0000-0003-3925-6102>, J.S. <https://orcid.org/0000-0002-5156-5277>,
D.N. <https://orcid.org/0000-0001-6159-5595>, J.P.R. <https://orcid.org/0000-0002-6116-3271>, B.M. <https://orcid.org/0000-0001-8573-0771>,
I.C. <https://orcid.org/0000-0001-5687-9577>, A.A. <https://orcid.org/0000-0003-3518-1991>

ABSTRACT

In many scientific papers, the term biosecurity measures (BSMs) are defined as the implementation of segregation, sanitation or management procedures specifically designed to reduce the likelihood of the introduction, establishment, survival or spread of a potential pathogen into, within or from a farm or geographical area. The main BSMs (general external and internal BSMs related to newly introduced animals, farm workers, family members, visitors and service providers, vehicles, tools and equipment, location of farms, water and feed, control programs, management practices, handling of raw materials, work procedures, training, plans and records), based on literature data, guides, instructions, recommendation codes and checklists, are presented in the paper. In addition to the BSMs mentioned, the importance of segregation, cleaning and disinfection is emphasized. The most important and effective part of biosecurity is to keep infected animals and contaminated material away from non-infected animals. Cleaning and disinfecting barns, vehicles and equipment, especially boots and clothing, is a very effective way to minimize the transmission of disease to or between animals. It is very important to implement BSMs as a long-standing and successful practice on farms to maintain animal health. These measures should be included in a comprehensive biosecurity plan, which is tailored to farms characteristics and needs that must be fully implemented. A biosecurity plan and the design and implementation of biosecurity programs should address how farmers handle animals, vehicles and human access to the farm, as well as animal health and work procedures. Key BSMs should be followed on an ongoing basis and, working with veterinarians, farmers themselves can play an important role in keeping animals and production as healthy as possible. It is important to regularly assess the implementation of BSMs using appropriate questionnaires, which can highlight deficiencies that should be addressed immediately.

Keywords: ruminants, BSMs, biosecurity plan and program, questionnaire

INTRODUCTION

Nowadays, biosecurity is clearly defined and considered as a central part of the One Health concept. However, although the term biosecurity

measures (BSMs) has been used for years, there is still no consistent definition. According to the Food and Agriculture Organization of the United Nations, "biosecurity is a strategic and integrated concept that encompasses the policy and regulatory frameworks

(including tools and activities) used to analyse and manage risks in the areas of food safety, public health, animal life and health, and plant life and health, including associated environmental risks." (1).

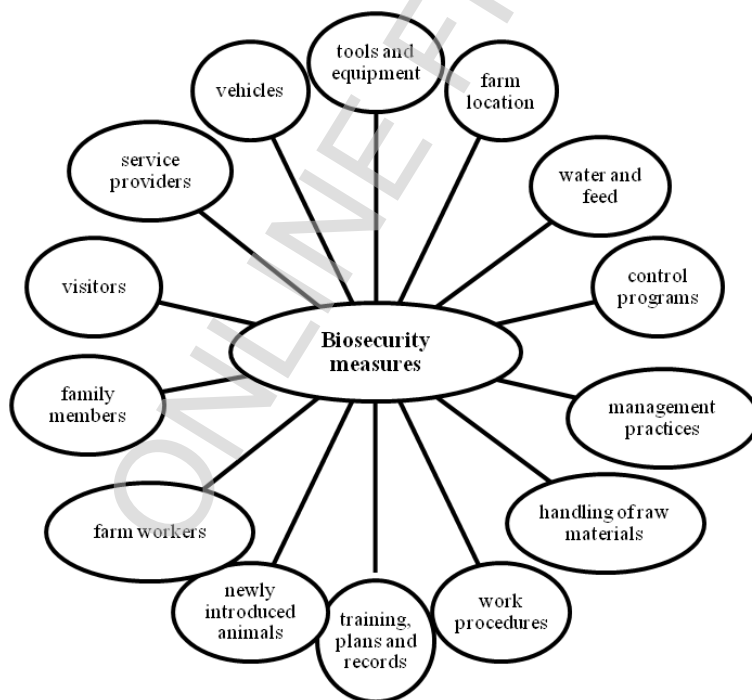
Considering that the unclear definition of BSMs, especially at the farm and policy level, can lead to misunderstandings, low acceptance, poor implementation and thus suboptimal biosecurity along the food production chain, Huber et al. (2) defined BSM as the implementation of a segregation, sanitation or management procedure specifically aimed at reducing the likelihood of the introduction, establishment, survival or spread of potential pathogens into, within or from a farm or geographical area.

This paper aims to familiarize field veterinarians and farmers with the most important BSMs, i.e. essentially the most important general

external and internal BSMs related to, newly introduced animals, farm workers, family members, visitors and service providers, vehicles, tools and equipment, the farm location, water and feed, control programs, management practices, handling of raw materials, work procedures, training, plans and records, which would help them to increase the knowledge, motivate stakeholders and improve cooperation.

BIOSECURITY MEASURES

Graph 1 shows biosecurity measures related to newly introduced animals, farm workers, family members, visitors and service providers, vehicles, tools and equipment, farm location, water and feed, control programs, management practices, raw material handling, work procedures, training, plans and records.



Graph 1. Biosecurity measures on ruminant farms

INTRODUCTION, ISOLATION AND MOVEMENT OF ANIMALS

Movements of domestic and wild animal populations are important for the spread of disease. Many recent examples of disease spread are due to the intentional movement of livestock or wildlife. Understanding the extent of these movements and

the associated risks is fundamental to clarifying the epidemiology of these diseases, some of which may pose zoonotic risks. The importance of global animal trade is reviewed and the role of unregulated trade in animals is highlighted. Several key examples are discussed where animal movements have introduced pathogens into previously disease-free areas. Measures based on enhanced surveillance

are proposed to mitigate the risks of introducing new pathogens (3). It is important to consider animal movement contacts between holdings of different production types (4, 5), the knowledge, attitude, and practice of nomadic and semi-nomadic pastoralists (6, 7) and the role of auction markets in cattle movements (8).

Numerous studies have shown that the introduction of new animals to the farm and the movement of animals (transport and reintroduction of animals) plays an important role in the spread of disease (3, 8 - 11), which is why maintaining a closed herd is one of the most important BSMs in disease prevention (3-5, 10, 12 - 15). Trade in small ruminants and their products is of great importance for biosecurity, as sheep and goats can transmit zoonotic diseases such as Rift Valley fever, Crimean-Congo hemorrhagic fever, brucellosis and listeriosis (16). Therefore, management procedures related to the introduction and movement of animals in a way that minimizes the risk of introducing or spreading infectious diseases are of paramount importance.

The review by Mee et al. (15) discusses evidence for many transmission routes as an introduction of infectious agents onto dairy and beef farms, which can occur through direct transmission (purchased cattle, reintroduced native cattle and contact with neighbouring cattle) or indirect transmission (faeces, visitors, other species and biological material). In the absence of eradication programs for many endemic infectious diseases, bioexclusion is the most important management technique for risk reduction. The greatest risk for the introduction of infectious agents is posed by the purchase of animals where the new arrivals are in direct contact with the recipient herd over a longer time (11).

As newly purchased animals entering the farm pose a high risk for the unintentional introduction of pathogens, it is necessary to check the health status of the animals before purchase. This means firstly that the animals should only be purchased from farms with the same or higher health status, then the animals should not be purchased from herds with lameness, abscesses, sore mouth, ringworm, cloudy eyes or other clinical signs of disease, and the animals intended for purchase should be examined, paying particular attention to misshapen, deformed or recently pared hooves. Care should also be taken to ensure that animals coming from areas where there are known problems with

anthelmintic-resistant worms are dewormed and faecal tested before arrival to ensure that no resistant parasites are introduced into the herd (16 - 23).

Segregation, observation and, if necessary, treatment of newly introduced animals in quarantine, i.e. isolation in separate pens depending on the situation, separation of the quarantine facilities from the area where the rest of the herd is kept, testing of animals for certain diseases in the quarantine facilities, quarantine of all newly arrived animals for a certain period and preferably until after birth, should be implemented. In addition, newly arrived animals must be routinely dewormed and all disease tests, treatments, procedures and vaccinations must be completed before the animals are released from isolation. Quarantine paddocks or pens should be located as close as possible to the farm entrance and away from other animals. There should be a double fence with a minimum distance of 3 metres between the newly arrived animals and the resident animals. In general, farmers should bear in mind that it is best to rear as many replacement animals as possible on their farm and only add new animals from other farms if necessary (10, 18 - 24).

When transporting animals to exhibitions, fairs and sales, it must be borne in mind that the transported animals can also transmit diseases to other animals through mixing or contact with pens, vehicles, people and equipment. To prevent the transmission of diseases in this way, animals must not leave the holding until they have been approved by the competent authority. It must also be ensured that all animals participating in a show or mela undergo a compulsory veterinary examination before unloading and that animals showing signs of disease are not unloaded. In addition, it should be ensured that animals that have recently given birth or have aborted or may give birth at the time of the show are excluded due to the risk of transmission of infectious abortive diseases. Animals should only be transported in a vehicle that has been cleaned and disinfected before use. It is important to avoid direct contact with other animals and to limit proximity to other animals during transportation and on-site. Farmer must bring bedding and feed from the farm and ensure a clean water supply on-site and bring feeders, water buckets and grooming and handling equipment from the farm. The handling of farm animals by other persons must be restricted. The welfare of the animals should be taken into account following transportation regulations when

transporting animals that are sold and taken away from the farm (18 - 24).

Knowledge of the health status of animals returning to the farm (e.g. animals participating in shows, etc.) is of particular importance to minimize the risk of introducing and spreading diseases in the existing herd. With this in mind, it must be ensured that animals leaving and returning to the farm are separated for a certain period to assess their susceptibility to infection. This should take into account hygiene measures and contact with other animals during the absence. Returning animals should then be tested in consultation with a veterinarian before being housed or relocated (tests to determine disease status may include serology, culture and faecal egg count). The animal should remain in isolation until test results are available. Care should be taken during isolation to ensure that no clinical signs of the disease are detected and a plan should be put in place for animals with positive test results, e.g. treatment, no purchase or disposal, no sharing of feeding or watering facilities, pens, handling facilities or equipment of isolated and housed animals unless these have been previously cleaned and disinfected. Finally, all disease tests, treatments, procedures and vaccinations should be completed before animals are released from isolation (18 - 24).

In isolation and movement control, should be also considered that the farm is surrounded by a natural barrier or a fence, that the number of access points to the farm is minimized and access to the farm is restricted, that the movement of people and vehicles on and around the property is minimized, that contact with animals from other herds is not allowed during grazing, that measures are taken to prevent direct contact between animals and wildlife, and finally that measures are taken to prevent direct contact between ruminants and other animal species (20 - 23).

In addition, should be remembered to designate "approved access areas" for farm contractors (e.g. veterinarians, animal caretakers, artificial insemination staff, and hay suppliers), delivery and collection vehicles (e.g. milk tankers, livestock trucks and feed) and service personnel (e.g. supply technicians, officials). Also, delivery and collection vehicles (e.g. milk tankers, livestock trucks and feed) and service personnel (e.g. supply technicians, government officials) should be identified and signposted as necessary, and facilities should be provided in "approved access areas" for

farm contractors and visitors to clean boots and equipment on arrival and before departure (20 - 23).

In studies of biosecurity on cattle farms in North West England, there were large differences between farms in the type and extent of BSMs. The majority of farmers did not isolate purchased animals, while a small proportion always isolated animals. Many farmers carried out post-movement treatments, mainly vaccinations and anthelmintics, but very few farms reported that they carried out post-movement health checks. In addition, there appeared to be wide variation in the level of BSMs carried out by the different companies and contractors that visited the farms. Rendering companies and contracted distributors of animal waste rarely disinfect themselves and their vehicles, even though the likelihood of contact with infectious agents is high. These findings suggest that while certain biosecurity practices are being implemented, many of them are rarely or never used. This may be due to many factors, including cost (time and money), lack of proven effectiveness of the practices, and lack of training of veterinarians, producers and other herd health professionals. If preventive medicine is to be fully utilized by the farming industry, further research into the reasons for the lack of uptake is essential (25).

FARM WORKERS, FAMILY MEMBERS, VISITORS AND SERVICE PROVIDERS

The people entering the farm are mainly farm workers, family members, visitors and service providers. It must be ensured that their activities and movements do not endanger the health of humans and animals. To ensure this, workers employed on the farm must take BSMs. This includes ensuring that all farm workers know and understand the biosecurity practices on the farm and are willing to implement them and also follow changes to the plan and practices. In addition, it must be ensured that in the event of a visit from service providers or visitors, all employees on the farm are informed. Numerous studies have shown that restricted access for visitors is a biosecurity measure that is not often applied (25 - 28).

The movement of owners, employees, visitors, veterinarians and service providers is commonplace on a farm and increases the risk of disease introduction and spread. Measures can be developed and implemented to reduce these risks. Access to farms should be restricted by establishing

different zones with different levels of protection. These zones should be demarcated by boundaries and appropriate signage. The movement of people into a designated zone, out of a designated zone and between designated zones can be controlled through the use of controlled access points (22, 23)

Several important biosecurity principles should be followed as much as possible, i.e.: all personnel are exclusive to the farm (i.e., not shared with other farms), visitors who do not necessarily need to come into contact with the animals, such as salespeople, consultants, etc., are not allowed to have contact with the animals, visitors who need to come into contact with the animals, such as veterinarians, shearing personnel, hoof trimmers, etc., are provided with boots/shoe covers and overalls on the farm, place footbaths at the entrance to the premises, define and place signs where appropriate, ensure that working practices are designed to minimize the movement of people, vehicles or equipment into areas where animals are kept and keep records of visitors to the farm (19).

All visitors and service providers must be aware of and prepared for the applicable biosecurity practices before their visit. Upon entering the farm, all visitors and service providers must register their visit in the visitor register. Once registered, all those entering, working or visiting the farm must wash and disinfect their hands when entering and leaving the farm premises, when moving between areas, and when entering or exiting certain designated risk areas of the premises, such as isolation or sick bays. Hands should also be washed or disinfected before and after any contact with animals, especially sick animals or animals of unknown health status, after contact with potentially contaminated materials such as dead animals, aborted fetuses, placenta or manure (18, 21 - 24).

After washing hands at the entrance, visitors and service providers must be briefed about the layout of the farm, which areas they are permitted to access, and what biosecurity practices need to be applied in that location. In doing so, it is necessary to ensure that visitors and service providers access only areas of the farm that are necessary and to allow contact with animals only when necessary. It is of great importance to encourage the use of personal protective equipment when visitors and service providers move onto farm property. Also, visitors and service providers are to be explained about the use of personal protective equipment, how

to put it on and remove it as well as where they should dispose of it (20 - 23).

In addition, should be remembered to meet with farm workers and their family members at least twice a year to discuss the benefits and effectiveness of each biosecurity plan practice. Basic things such as leaving the animal area without cleaning clothes of contaminants such as animal feces, or leaving the animal area without cleaning and sanitizing shoes may be discussed in such meetings (19, 22, 23).

VEHICLES, TOOLS AND EQUIPMENT

It would be difficult to control and monitor the spread of disease without restricting parking and vehicle movements within the premises. The biosecurity measure stipulates that vehicles moving from farm to farm may only enter the farm if they have been cleaned and disinfected in such a way that any contamination of the underbody or exterior of the vehicle cannot enter the farm. It should be borne in mind that several unsecured entrances to the farm make it difficult to monitor and control the entry of vehicles into the premises. Therefore, only one or two routes should be used to enter the premises.

Livestock transport vehicles should be loaded and unloaded at the perimeter of the premises and the animals can then be led to the isolation area. Feed vehicles should also be unloaded or loaded in designated areas, preferably close to the feed outlets, without entering the main area of the farm. It should be ensured that trucks used for the transportation of feed or silage are not used for purposes that pose a biosecurity risk to the herd and that they are cleaned appropriately before use (20 - 24).

Essentially, when transporting ruminants, only animals that are in a fit condition for loading are selected to minimize the potential spread of disease and/or contamination through transport, transport vehicles for animals, feed, supplies, maintenance, etc. are only allowed to enter and leave the farm premises if they are properly disinfected, and transport vehicles for removal (i.e. to slaughter, feed stores, etc.) arrive at the farm empty (i.e. without other animals), cleaned and disinfected. Particular care shall be taken to ensure that dead animals and/or animal materials are collected by a rendering vehicle and that the rendering vehicle can remove dead animals without entering the premises of the holding (20 - 23).

Cleaning and disinfection is the most important biosecurity tool for reducing the risk of

vehicle-borne disease. A washing area should be provided for vehicles that must enter the farm premises. If possible, a high-pressure washing system should be used to clean vehicles and equipment, away from crops or animals. It must also be ensured that the wastewater from the washing facility is diverted away from the production areas of the farm. If it is not possible to secure the washing area, it must be ensured that vehicles entering the farm pass through a wheel washing facility installed at the entrance to the farm. Finally, it is important to keep a vehicle register in which all necessary information is properly entered when entering and leaving the facility (20 - 24).

The risk of disease spread is higher when equipment is borrowed, lent or purchased second-hand from other properties. It must be ensured that the movement and use of equipment and machinery does not endanger human and animal health in any way, not only within the farm but also in other farms in the vicinity. It is best to minimize the lending and borrowing of equipment between properties. If equipment is borrowed, it should be ensured that it is cleaned before and after use. We also need special tools, clothing and footwear available for specific areas such as production areas or isolation areas where sick or quarantined animals are kept. Cleaning and disinfection of needles, tools, etc., between each use, and especially between herds is of paramount importance (20 - 22).

LOCATION OF FARMS

The risk of disease increases many times over if the farm is located near other farms, slaughterhouses, livestock markets, waste disposal facilities and rendering centres (20 - 22). The location near animal transport routes and waterways also increases the risk. The orientation of stables, buildings, ventilation inlets and outlets, unloading and loading areas, treatment and isolation or quarantine stations should be chosen to minimise the risk of disease introduction and spread (20 - 22). Separate rearing areas for young, sick and new animals with visibly demarcated areas reduce the risk of disease transmission. Natural features such as vegetation, watercourses and topography can benefit a biosecurity plan as they provide natural barriers and drainage opportunities (22, 23).

FEED AND WATER

Feed can be a source of contamination, infection or infestation and can carry or harbour pathogens, chemical residues, weed seeds and pests. Incorrectly stored feed can also spoil, develop unwanted pathogens (e.g. mould) or become contaminated by pests and vermin (11, 22, 23). Important BSMs include purchasing livestock feed from reliable suppliers who pay attention to hygiene and quality, comply with the regulations for feed for feeding ruminants and ensure that it is transported in a clean means of transport (20, 22). It must be ensured that feed is only unloaded after inspection for signs of pests, damage and contamination. It is necessary to check feed for ruminants by taking feed and feed samples from each batch. In addition, ruminant feed must be labelled and stored in such a way that it can be tested at a later date for quality and, if necessary, for the presence of toxins. Store feed in such a way as to avoid contamination from livestock, vermin, wildlife, wild and domestic animals and other feedstuffs. It is extremely important to ensure that ruminants are not fed with products derived from vertebrates, except for tallow and gelatine. When supplying water, care must be taken to ensure that the quantity and quality of the water provided is suitable for the type of ruminant. The quality of drinking water for ruminants should be checked at least once a year by bacteriological analysis. Regular testing of water, soil, feed and fodder is very important when implementing the biosecurity plan at the farm level (22). Water sources are contaminated by faeces or urine and can expose animals to pathogens; they should be cleaned regularly. Manure and dirty water can pose a biohazard as *Escherichia coli* O157, *Salmonella* and *Campylobacter* can survive for up to 3 months (29).

CONTROL PROGRAMS

Control programs are very important elements of biosecurity on ruminant farms (20 - 23). They include written protocols for hygiene procedures, vaccination programs for diseases recommended by a licensed veterinarian (for example in small ruminants - the most common clostridial diseases: *Clostridium perfringens* types C and D and tetanus, tetanus, caseous lymphadenitis, vibrio and chlamydial abortion, epididymitis and hoof rot), a parasite control program that combines management practices with targeted selective deworming, a rodent control program, an insect control program, an avian control program and

ensuring controls for the potential spread of disease through carcasses and effluent. Carcasses serve as reservoirs for pathogens, attract pests and are a source for the transmission of pathogens. Various methods of cadaver disposal, including burial, landfilling, incineration, recycling, composting and alkaline hydrolysis, have been reviewed by Nutsch and Kastner (30).

MANAGEMENT PRACTICES

Management practices are also essential elements of biosecurity on ruminant farms (21 - 23). These include a system for identification and traceability of animals, at least annual veterinary inspection of calving, lambing and kidding pens, cleaning and disinfection of materials used for feeding calves/lambs/kids (colostrum, milk, etc.) after birth, separate pens (from maternity and quarantine pens) for sick animals (hospital pens), hospital pens are cleaned and disinfected after each use, aborted animals are tested for non-notifiable diseases, semen is obtained from reputable sources, the application of effluent and manure, particularly of high-risk species, is regulated to minimize the spread of disease through contamination of pasture, feed and water, and vermin, feral animals, weeds and wildlife populations are monitored and regulated to prevent impact on ruminants (20 - 24).

WORKING ROUTINES

Inaccuracies are often made when implementing daily work routines, which are important BSMs. These include the regular inspection of livestock for early detection of sick animals, work routines for farm staff (e.g., the working procedures for farm personnel, e.g., from younger to older animals) should be established, bedding material should be appropriate, wastewater should be collected and contained to prevent access by humans and animals, carcasses and waste should be disposed of as quickly as possible, taking into account environmental and public considerations, disposal areas should be selected to avoid the potential spread of contaminants, disposal areas should be secured and contained to prevent access by livestock, wildlife, domestic animals and wildlife, and finally, regular inspections of properties should be carried out to assess potential biosecurity breaches (20 - 23).

TRAINING, PLANNING AND RECORDING

Planning and recording the implementation of BSMs enables systematic implementation. In this sense, the training of farmers is extremely important. Therefore, a biosecurity plan must be developed for the farm that includes training, planning and recording. Staff should fully understand their role in implementing on-farm biosecurity practices through an introduction to the biosecurity management plan, ongoing biosecurity training and regular review of the on-farm biosecurity protocol. It is of paramount importance that staff responsible for animal husbandry know how to identify sick and injured ruminants and what to do if an animal disease is suspected. Finally, staff should know where to find the contact details of local veterinarians and relevant government officials (20 - 23).

CONSIDERATION OF BIOSECURITY MEASURES

In the literature, one encounters various studies on the use of BSMs in ruminants, such as factors influencing the use of BSMs to protect ruminants and farm workers from infectious diseases (31), the evaluation of biosecurity practices in the production, marketing and slaughter of cattle, sheep and goats (32) and the use of a questionnaire to assess biosecurity in Finnish cattle, pig and sheep farms (26). Various topics were also discussed in connection with cattle, such as biosecurity on cattle farms (25, 33), the basics of biosecurity on cattle farms and good management practices to control infectious diseases (34), the drivers for collective BSMs among cattle and sheep farmers (35), biosecurity standards on cattle farms (36) and a survey on biosecurity and management practices on selected Belgian cattle farms (27). Biosecurity practices on dairy farms have been described in numerous countries such as Brazil (37), Australia (38), Ireland (10) and Canada (39). In addition, biosecurity, health and culling in expanding dairy herds (40) and biosecurity in gastrointestinal diseases of adult dairy cows (12) were considered. Biosecurity and management (13), biosecurity and the management of emergency animal disease (28), biocontainment, biosecurity and security practices (41) and bioexclusion of diseases from dairy and beef farms (15) are topics that have been discussed concerning biosecurity on beef farms.

Numerous papers point out the importance of BSM implementation at the farm level on different farms in maintaining ruminant health (15, 35, 40 - 45). In addition to the health of ruminants, the implementation of BSMs on ruminant farms is also very important for the prevention of zoonoses (46, 47, 48, 49, 50). The literature emphasizes that most priority bioterrorism agents are zoonotic in origin and that animals could provide an early warning to humans if clinical signs were detected before the onset of human disease or early enough to initiate preventive measures (51).

Studies in the United Kingdom (UK) have shown that farmers and vets have their own relatively clear definitions of biosecurity concerning some key diseases that threaten UK agriculture. Overall, farmers believe that other stakeholders, such as the government, should have more influence on biosecurity in the UK. Conversely, vets saw the ability or willingness of their clients to invest in BSMs as a major barrier. Vets also felt that additional evidence of effectiveness and/or better evidence of the potential economic benefits of proposed on-farm BSMs were needed. Ancillary industries were generally unsure of their role in biosecurity, although study participants highlighted zoonoses as part of the problem and indicated that most barriers exist at the farm level (45).

Studies on farm biosecurity, as perceived by professionals visiting Swedish farms, have revealed many obstacles, especially on sheep and goat farms. Visitors reported that conditions on farms did not allow for an adequate level of biosecurity and that many farmers did not require biosecurity routines, while farmers reported that they expected all visitors to behave professionally and take responsibility for not spreading diseases (52).

Studies on the perceptions and practices of rural veterinarians concerning biosecurity in three European countries revealed different strengths, weaknesses, possible limitations and solutions concerning the veterinary perspective. Veterinarians are seen as key informants by farmers and could therefore play a more active role in advising and improving biosecurity at the farm level. Based on the survey results, two factors appeared to significantly influence the level of implementation of the measures: the country in which the veterinarian practices and the veterinarian's perception of biosecurity. The biosecurity levels with the lowest level of implementation, and therefore posing the greatest risks, were

biocontainment and biocontrol (53). It is understood that a sound knowledge of veterinary epidemiology is required to develop disease control programs and implement biosecurity programs at farm, regional and national levels (54).

Farmers have a significant role in the implementation of BSMs. Research on the application of routines that contribute to biosecurity on farms, as reported by Swedish livestock farmers, has shown that a lower level of BSMs is applied on farms with cattle, sheep, goats and mixed species than on pig farms (14). The process of learning about biosecurity and the factors that influence its implementation by farmers is related to the essence of changing human behaviour. To bring about effective change in current biosecurity practices, advisors and farm managers need to understand what motivates and influences workers to use biosecurity (42). Knowledge of the impact of human actions on the risk of infectious diseases (43), opinions and practices of dairy farmers concerning biosecurity and animal welfare (44), determinants of biosecurity behaviour of cattle and sheep farmers in terms of economic analysis (55) are very important aspects.

Various aspects of sheep and goat biosecurity are described in publications on the biosecurity status of small ruminant farms (56), the relationship between structural characteristics and the biosecurity of sheep farms (57) and the implementation of biosecurity in small ruminant farms (58). Different publications further described best management practices for dairy goat farmers (59), biosecurity on sheep farms (20), biosecurity planning guide for goat producers (60), biosecurity for goats (61), biosecurity for sheep and goat producers (24), a national biosecurity planning guide for sheep producers (22) and a national manual for farm biosecurity - grazing animal production (23).

Mixed livestock systems are common in developing countries. A very illustrative example of the application of BSMs in these systems is the study of selected farmers in Australia (38). The results of this study show that 69% of farms operate a mixed livestock system, with the majority of farms keeping either sheep or cattle on the same property as dairy cattle. Around half of the farms (49%) did not provide formal training on animal health aspects to new employees and did not monitor the health of bulls. Most farms (98%) required their employees to wear personal protective equipment such as overalls and boots, but only a few farms (34%) had designated areas for cleaning footwear and a system

for recording visitors (17%). Most farms kept records of animal health, fence maintenance and the use of supplier declaration forms. The practice of quarantining new animals before bringing them together with other animals was only used on 45% of farms and 55% of farms carried out monthly health visits by a veterinarian.

BSMs are particularly important in "open" herds where ruminants come into contact with animals from other farms (purchase of breeding stock, participation in livestock shows, shared grazing areas, etc.), where more stringent BSMs (i.e. isolation of incoming animals, clinical examinations, laboratory tests, vaccinations, etc.) should be implemented than in closed herds (33).

The risk of introduction and the effect of BSMs varied depending on the type of farm and the transmission route of the disease. Adapting contact patterns to mitigate a particular disease risk was as important as BSMs for some farm types, but the greatest effect was observed when BSMs were combined with better-planned contact patterns. The risk assessment model proved useful for illustrating the risk of endemic disease introduction and the mitigating effect of different BSMs at the farm level (62).

A cross-sectional mixed methods study in Kenya, which included 26 focus group discussions with community members and 10 observational interviews with abattoir staff, a household survey with 560 community members and a separate survey of 231 livestock traders, found that producers, traders and abattoir staff followed some biosecurity practices but not others. The study concluded that implementing BSMs in rural areas is more complex than the biosecurity strategies and frameworks that stipulate them. It also showed that resource constraints, poor implementation and difficult cultural practices can hinder this. Also, the study recommends conducting further studies on the willingness to adopt BSMs targeting community members in resource-poor areas to identify possible critical intervention points at district and state levels (32).

A study of biosecurity practices of cattle herds in Western Canada by Wennekamp et al. (39) found that 54% of herds purchased heifers and 42% purchased cows. The use of standard biosecurity practices was generally low: 30% of producers kept purchased animals separated and 30% of new arrivals were vaccinated. None of the biosecurity

practices assessed were associated with the reporting of Johne's disease. The purchase of more than 10 bulls, the purchase of cows, unvaccinated purchased animals and the use of communal pastures were associated with outbreaks of bovine respiratory disease. Outbreaks of calf diarrhoea were associated with the purchase of 10 or more bulls, the use of a communal pasture and the leasing or sharing of bulls.

It is essential to regularly assess the implementation of BSMs using appropriate questionnaires (14, 26, 27, 52, 63). To assess the biosecurity of dairy cattle, beef cattle, veal calves, small ruminants dairy and small ruminants meat, the questionnaires of the University of Ghent can be used (see link: Biocheck ugent: <https://biocheckgent.com/en/surveys>), which can highlight shortcomings that should be addressed immediately. To evaluate the success of the implementation of BSMs, risk assessment is very important as a tool to improve external biosecurity (62). An overview of the methods used to assess biosecurity risk on dairy farms can be found in the paper of Stanković et al. (64), in the Biosecurity Toolkit (1) and in the Guidelines for Import Risk Analysis (65).

CONCLUSIONS

It is very important to implement biosecurity principles and measures as long-standing and successful practices on farms to keep ruminants healthy. These principles and measures should be included in a comprehensive biosecurity plan. A biosecurity plan should address how farmers manage animals, vehicles and human access on the farm, animal health and operations. The most important biosecurity principles should be followed continuously, and in cooperation with government officers and veterinarians, farmers enable themselves to play a significant role in keeping the animals and the production as healthy as possible.

ACKNOWLEDGEMENTS

This publication is based on work from COST action CA20103, "Biosecurity enhanced through training evaluation and raising awareness (BETTER)," supported by European Cooperation in Science and Technology (COST).

REFERENCES

1. FAO. *Biosecurity Principles and Components. Part. 1. In FAO Biosecurity Toolkit; Food and Agriculture Organization of the United Nations: Rome, Italy, 2007; pp. 1–20. Available at: <https://www.fao.org/4/a1140e/a1140e01.pdf> (Accessed on: 09-05-2024.).*
2. Huber N., Andraud, M., Sassu, E.L., Prigge C., Zoche-Golob V., Käsbohrer A., D'Angelantonio D., Viltrop, A., Zmudzki, J., Jones, H., Smith, R., Tobias, T., Burow E. What is a biosecurity measure? A definition proposal for animal production and linked processing operations. *One Health* 2022, 15, 100433.
3. Fèvre E. M., Bronsvoort B.M.D.C., Hamilton K.A., Cleaveland S. Animal movements and the spread of infectious diseases. *Trends in microbiology* 2006, 14(3), 125-131.
4. Lindström T., Sisson S.A., Stenberg Lewerin S., Wennergren U. Estimating animal movement contacts between holdings of different production types. *Preventive Veterinary Medicine* 2010, 95, 23–31.
5. Nöremark M., Håkansson N., Sternberg-Lewerin S., Lindberg A., Jonsson, A. Network analysis of cattle and pig movements in Sweden: Measures relevant for disease control and risk based surveillance. *Preventive Veterinary Medicine* 2011, 98, 78–90.
6. Jafari-Gh A., Laven R. A., Eila N., Yadi J., Hatami Z., Soleimani P., Jafari-Gh S., Moazez Lesko M., Heidari E. Transboundary and infectious diseases of small ruminants: Knowledge, attitude, and practice of nomadic and semi-nomadic pastoralists in northern Iran. *Small Ruminant Research* 2020, 183, 106039.
7. Njenga M.K., Ogolla E., Thumbi S. M., Ngere I., Omulo S., Muturi M., Marwanga D., Bitek A., Bett B., Widdowson M.A., Peninah Munyua Osoro E.M. Comparison of knowledge, attitude, and practices of animal and human brucellosis between nomadic pastoralists and non-pastoralists in Kenya. *BMC public health* 2020, 20, 1-10.
8. Robinson S.E., Christley R.M. Exploring the role of auction markets in cattle movements within Great Britain. *Preventive Veterinary Medicine* 2007, 81, 21–37.
9. Hosie B., Clark S. Sheep flock health security. *In practice*, 2007, 29(5), 246-254.
10. Sayers R.G., Sayers G.P., Mee J.F., Good M., Birmingham M.L., Grant J., Dillon P.G. Implementing BSMs on dairy farms in Ireland. *The Veterinary Journal* 2013, 197(2), 259-267.
11. Manuja B.K., Manuja A., Singh R.K. Globalization and livestock biosecurity. *Agricultural Research*, 2014, 3, 22-31.
12. Wells S.J., Dee S., Godden S. Biosecurity of gastrointestinal diseases of adult dairy cattle. *Veterinary Clinics of North America: Food Animal Practice*, 2002, 18, 35–55.
13. Caldwell G. Biosecurity, does it have a place in the management of beef herds in the United Kingdom? *Cattle Practice* 2004. 12, 149–153.
14. Nöremark M., Frössling J., Lewerin, S.S. Application of routines that contribute to on-farm biosecurity as reported by Swedish livestock farmers. *Transboundary and emerging diseases* 2010, 57(4), 225-236.
15. Mee J.F., Geraghty T., O'Neill R., More S.J. Bioexclusion of diseases from dairy and beef farms: Risks of introducing infectious agents and risk reduction *The Veterinary Journal* 2012, 194, 143–150.
16. Sherman D.M. The spread of pathogens through trade in small ruminants and their products. *Revue Scientifique et Technique-OIE* 2011, 30(1), 207.
17. Szamand A., Alipoor G., Zafari S., Zolhavarieh S.M., Alanazi A.D., Sargison N.D. Assessment of Knowledge, Attitudes and Practices Relating to Parasitic Diseases and Anthelmintic Resistance Among Livestock Farmers in Hamedan, Iran. *Frontiers in veterinary science* 2020, 7, 584323.
18. Dewulf J., Van Immerseel F. General principles of biosecurity in animal production and veterinary medicine. *In Biosecurity in animal production and veterinary medicine. Eds. Dewulf J., Van Immerseel, F. CABI, 2019, pp. 63-76.*
19. Dewulf J., Van Immerseel F. *Biosecurity in animal production and veterinary medicine. CABI, 2019.*
20. Government of India. 2016. *General Guidelines for Biosecurity at Central Sheep Breeding Farm, Hisar. Available at: <https://www.dof.gov.in/sites/default/files/2019-12/Biosecurity%20guidelines%20for%20sheep%20and%20goat%20.pdf> (Accessed on: 09-05-2024.).*
21. Canadian Food Inspection Agency. 2011. *National farm-level biosecurity planning guide proactive management of animal resources. Available at: <http://www.inspection.gc.ca/animals/terrestrial-animals/biosecurity/standards-and-principles/proactive-management/eng/1374175296768/1374176128059?chap=6> (Accessed on: 09-05-2024.).*
22. Canadian Food Inspection Agency. 2013. *The National Sheep Producer Biosecurity Planning Guide. Available at: <https://publications.gc.ca/site/eng/470917/publication.html?wbdisable=false> (Accessed on: 09-05-2024.).*

23. *Animal Health Australia*. 2018. *National Farm Biosecurity Manual - Grazing Livestock Production*. Available at: <https://www.farmbiosecurity.com.au/wp-content/uploads/2019/02/National-Farm-Biosecurity-Manual-Grazing-Livestock.pdf> (Accessed on: 09-05-2024.).
24. U.S. Department of agriculture. 2024. *Biosecurity for Sheep and Goat Producers*. Available at: https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/sa_animal_disease_information/sheep-goat/biosecurity (Accessed on: 09-05-2024.).
25. Brennan M. L., Christley R.M. Biosecurity on cattle farms: a study in north-west England. *PloS one* 2012, 7(1), e28139.
26. Sahlström L., Virtanen, T., Kyyrö, J., Lyytikäinen, T. Biosecurity on Finnish cattle, pig and sheep farms—results from a questionnaire. *Preventive Veterinary Medicine* 2014, 117(1), 59-67.
27. Sarrazin S, Cay AB, Laureyns J, Dewulf J. A survey on biosecurity and management practices in selected Belgian cattle farms. *Prev Vet Med.* 2014, 117:129–139.
28. Hernández-Jover M, Higgins V, Bryant M, Rast L, McShane C. Biosecurity and the management of emergency animal disease among commercial beef producers in New South Wales and Queensland (Australia). *Prev Vet Med.* 2016,134:92–102.
29. Nicholson F.A., Groves S.J., Chambers B.J. Pathogen survival during livestock manure storage and following land application. *Bioresour Technol* 2005, 96:135–143.
30. Nutsch A, Kastner J. *Carcass Disposal Options*. In: *Wiley Handbook of Science and Technology for Homeland Security*. Ed J.Voeller. Wiley, New York, 2008, 1959–1969.
31. Msimang V., Rostal M.K., Cordel C., Machalaba C., Tempia S., Bagge W., Burt F.J., Karesh W.B., Paweska J.T., Thompson P.N. Factors affecting the use of BSMs for the protection of ruminant livestock and farm workers against infectious diseases in central South Africa. *Transboundary and Emerging Diseases* 2022, 69(5), e1899-e1912.
32. Mutua E.N., Bett B.K., Bukachi S.A., Estambale B.A., Nyamongo I.K. From policy to practice: An assessment of biosecurity practices in cattle, sheep and goats production, marketing and slaughter in Baringo County, Kenya. *Plos One* 2022, 17(4), e0266449.
33. Valergakis G.E., Arsenos G., Oikonomou G. BSMs on cattle farms. *Journal of the Hellenic Veterinary Medical Society*, 2008, 59(1), 9-22.
34. Buhman M.J., Dewell G., Griffin D. 2000. *Biosecurity basics for cattle operations and good management practices (GMP) for controlling infectious diseases*. Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.
35. Heffernan C., Nielsen L., Thomson K., Gunn G. An exploration of the drivers to bio-security collective action among a sample of UK cattle and sheep farmers. *Preventive Veterinary Medicine*, 2008, 87, 358–372.
36. Stanković B., Hristov S. 2016. *Standardi biosigurnosti na farmama goveda. Poglavlje u monografiji: Optimizacija tehnoloških postupaka i zootehničkih resursa na farmama u cilju unapređenja održivosti proizvodnje mleka (Elektronski izvor]: monografija/urednik Vladan Bogdanović. - Beograd: Univerzitet, Poljoprivredni fakultet, 2016 (Beograd: Poljoprivredni fakultet). - 1 elektronski optički disk (CD-ROM); 12 cm, strana 183 - 210, ISBN 978-86-7834-212-7; CIP 637.1(082)(0.034.2); COBISS.SR-ID 227681036.*
37. Ferreira J.S., Baccili C.C., Nemoto B.S., Vieira F.K., Sviercoski L.M., Ienk T., Pagno J.T., Gomes V. Biosecurity practices in the dairy farms of southern Brazil. *Frontiers in Veterinary Science* 2024, 11, 1326688.
38. Aleri J.W., Laurence M. A description of biosecurity practices among selected dairy farmers across Australia. *Animal Production Science* 2020, 60(14), 1711-1720.
39. Wennekamp T.R., Waldner C.L., Parker S., Windeyer M.C., Larson K., Campbell J.R. Biosecurity practices in western Canadian cow-calf herds and their association with animal health. *The Canadian Veterinary Journal* 2021, 62(7), 712.
40. Faust M.A., Kinsel M.L., Kirkpatrick M.A. Characterising biosecurity, health, and culling during dairy herd expansions. *Journal of Dairy Science* 2021, 84, 955–965.
41. Brandt A.W., Sanderson M.W., DeGroot B.D., Thomson D.U., Hollis L.C. Biocontainment, biosecurity, and security practices in beef feedyards. *Journal of the American Veterinary Medical Association*, 2008, 232, 262–269.
42. Delabbio J., 2006. How farm workers learn to use and practice biosecurity. *Journal of Extension*, 2006, 44, 6FEA1.
43. Lindahl J.F., Grace D. The consequences of human actions on risks for infectious diseases: a review. *Infection ecology & epidemiology* 2015, 5(1), 30048.
44. Hoe F.G.H., Ruegg P.L. Opinions and practices of Wisconsin dairy producers about biosecurity and animal well-being. *Journal of Dairy Science* 2006, 89, 2297–2308.

45. Gunn G.J., Heffernan C., Hall M., McLeod A., Hovi M. Measuring and comparing constraints to improved biosecurity amongst GB farmers, veterinarians and the auxiliary industries. *Preventive Veterinary Medicine* 2008, 84, 310–323.
46. Ganter M. Zoonotic risks from small ruminants. *Veterinary microbiology* 2015, 181(1-2), 53-65.
47. Obonyo M., Gufu W.B. Knowledge, attitude and practices towards brucellosis among pastoral community in Kenya, 2013. *International Journal of Innovative Research and Development* 2015, 4(10), 375-84.
48. Nyokabi S., Birner R., Bett B., Isuyi L., Grace D., Güttler D., Lindahl J. Informal value chain actors' knowledge and perceptions about zoonotic diseases and biosecurity in Kenya and the importance for food safety and public health. *Tropical animal health and production* 2018, 50, 509-518.
49. Starič J., Hodnik J.J., Drusany Starič K., Ježek J., Janev Holcer N., Leppälä J., Rautiainen, R. 2020. Safety culture regarding zoonoses on domestic ruminant farms. *Veterinarska stanica* 2020, 51(2), 199-206.
50. Youssef D. M., Wieland B., Knight G.M., Lines J., Naylor N.R. The effectiveness of biosecurity interventions in reducing the transmission of bacteria from livestock to humans at the farm level: a systematic literature review. *Zoonoses and public health* 2021, 68(6), 549-562.
51. Rabinowitz P., Gordon Z., Chudnov D., Wilcox M., Odofin L., Liu A., Dein J. Animals as sentinels of bioterrorism agents. *Emerging Infectious Diseases* 2006, 12(4), 647.
52. Nöremark M., Sternberg-Lewerin S. On-farm biosecurity as perceived by professionals visiting Swedish farms. *Acta Veterinaria Scandinavica* 2014, 56(1), 1-11.
53. Renault V., Humblet M.F., Moons V., Bosquet G., Gauthier B., Cebrián L. M., Casal J., Saegerman C. Rural veterinarian's perception and practices in terms of biosecurity across three European countries. *Transboundary and Emerging Diseases* 2018, 65(1), e183-e193.
54. Robertson I.D. Disease control, prevention and on-farm biosecurity: the role of veterinary epidemiology. *Engineering* 2020, 6(1), 20-25.
55. Toma L., Stott A.W., Heffernan C., Ringrose S., Gunn G.J. Determinants of biosecurity behaviour of British cattle and sheep farmers - A behavioural economics analysis. *Preventive veterinary medicine* 2013, 108(4), 321-333.
56. Nooraisyah S., Nurulhuda M.O., Mohd-Shaharizan M.S., Azlina-Azma, I.A. Biosecurity Status of Small Ruminant Farms in Peninsular Malaysia. *Malaysian Journal of Veterinary Research* 2014, 291, 127.
57. Şen Ö.T., Durmuş M., Koluman N. Examination of Structural Characteristics and Biosecurity of Sheep Farms in Niğde Province. *Turkish Journal of Agriculture-Food Science and Technology* 2023, 11(10), 1847-1854.
58. Altınçekiç Ş.Ö., Koyuncu M. Applications of biosecurity in small ruminant livestock enterprises. *Hayvansal Üretim (Journal of Animal Production)*, 2015, 56(1), 48-57.
59. Hedrich C., Duemler C., Considine D. Best management practices for dairy goat farmers. University of Wisconsin Emerging Agricultural Markets Team-The Wisconsin Dairy Goat Association, USA, 2008.
60. Government of Canada. 2013. Biosecurity Planning Guide for Canadian Goat Producers. Available at: <https://inspection.canada.ca/animal-health/terrestrial-animals/biosecurity/standards-and-principles/producer-guide-goats/eng/1375213342187/1375213659306?chap=1> (Accessed on: 09-05-2024.).
61. U. S. Department Of Agriculture. 2021. Goat Biosecurity. Available at: <http://bit.ly/3c3xQjY> >, <https://goats.extension.org/goat-biosecurity/> (Accessed on: 09-05-2024.).
62. Lewerin S.S., Österberg J., Alenius S., Elvander M., Fellström C., Tråvén M., Wallgren P., Waller K.P., Jacobson, M. 2015. Risk assessment as a tool for improving external biosecurity at farm level. *BMC Veterinary Research*, 2015, 11, 1-10.
63. Emanuelson U., Sjöström K., Fall N. 2018. Biosecurity and animal disease management in organic and conventional Swedish dairy herds: a questionnaire study. *Acta veterinaria scandinavica*, 2018, 60, 1-7.
64. Stanković B., Hristov S., Relić R. 2018. Dairy farm biosecurity risk assessment methodology - a review. *Proceedings of International Symposium on Animal Science, November 22nd – 23rd 2018., Faculty of Agriculture, Belgrade-Zemun, Serbia*, pp. 223-230.
65. OIE. 2023. Import Risk Analysis - Guidelines for Risk Analysis. *Terrestrial Animal Health Code*.

BIOSIGURNOSNE MERE NA FARMAMA PREŽIVARA (PREVOD)

BIOSECURITY MEASURES ON RUMINANT FARMS

Slavča Hristov^{a*}, Branislav Stanković^a, Jože Starič^b, Dimitar Nakov^c, Jasna Prodanov-Radulović^d,
Bojan Milovanović^e, Ilias Chantziaras^f, Alberto Allepuz^g

^aUniverzitet u Beogradu - Poljoprivredni fakultet, Beograd-Zemun, Republika Srbija

^bVeterinarski fakultet, Ljubljana, Slovenija

^cPoljoprivredni fakultet Univerziteta Goce Delčev – Štip, Štip, Republika Severna Makedonija

^dNaučni institut za veterinarstvo „Novi Sad“, Novi Sad, Republika Srbija,

^eInstitut za veterinu Srbije, Beograd, Republika Srbija

^fJedinica za veterinarsku epidemiologiju, Fakultet veterinarske medicine, Univerzitet u Gentu, Belgija

^gOdsek za zdravlje i anatomiju životinja, Autonomni univerzitet u Barseloni, Španija

*Corresponding author: hristovs@agrif.bg.ac.rs

SAŽETAK

U brojnim naučnim radovima, termin biosigurnosne mere (BSM) se definiše kao implementacija segregacije, sanitarnih ili upravljačkih procedura ciljano dizajniranih da smanje verovatnoću unošenja, uspostavljanja, preživljavanja ili širenja potencijalnog patogena u farmu, unutar ili iz farme ili geografsko područje. U radu su prikazane glavne mere biosigurnosti (opšte mere eksterne i interne biosigurnosti koje se odnose na novouvedene životinje, radnike na farmi, članove porodice, posetioce i pružaoce usluga, vozila, alate i opremu, lokaciju farme, vodu i hranu za životinje, programe kontrole, prakse upravljanja, rukovanje sirovinama, radne postupke, obuku, planove i evidenciju) na osnovu podataka iz literature, vodiča, uputstava, preporuka i kontrolnih lista. Pored pomenutih mera biosigurnosti, istaknuti su značaj segregacije, čišćenja i dezinfekcije. Najvažniji i najefikasniji deo biosigurnosti je da se zaražene životinje i kontaminirani materijal drže dalje od neinficiranih životinja. Čišćenje i dezinfekcija štala, vozila i opreme (uključujući čizme i odecu) je veoma efikasan način da se minimizira prenošenje bolesti na ili između životinja. Veoma je mere biosigurnosti važno primeniti kao dugoročnu i uspešnu praksu na farmama za očuvanje zdravlja životinja. Ove mere treba da budu uključene u sveobuhvatni plan biosigurnosti koji se mora u potpunosti primeniti. Planovi biosigurnosti i dizajn i implementacija programa biosigurnosti treba da se pozabave načinom na koji farmeri postupaju sa životinjama, vozilima i pristupom ljudi farmi, kao i zdravljem životinja i radnim procedurama. Ključne mere biosigurnosti treba redovno pratiti i, radeći sa veterinarima, sami farmeri mogu da igraju važnu ulogu u održavanju zdravlja životinja i proizvodnje što je moguće zdravijim. Važno je redovno procenjivati sprovođenje mera biosigurnosti korišćenjem odgovarajućih upitnika, koji mogu da istaknu nedostatke koje treba odmah ukloniti.

Ključne reči: preživari, mere biosigurnosti, plan i program biosigurnosti, upitnici

Uvod

Danas je biosigurnost jasno definisana i smatra se centralnim delom koncepta jednog zdravlja. Međutim, iako se termin biosigurnosne mere (BSM) koristi godinama, još uvek ne postoji konzistentna definicija. Prema Organizaciji Ujedinjenih nacija za hranu i poljoprivredu "biosigurnost je strateški i integrisani koncept koji obuhvata politike i regulatorne okvire (uključujući sredstva i aktivnosti) koji se koriste za analizu i upravljanje rizicima u oblastima bezbednosti hrane, javnog zdravlja, života

i zdravlja životinja i biljaka, uključujući povezane rizike po životnu sredinu." (1).

Uzimajući u obzir da nejasna definicija BSM, posebno na nivou farme i politika, može dovesti do nesporazuma, slabog prihvatanja, loše implementacije i samim tim neoptimalne biosigurnosti u lancu proizvodnje hrane, Huber et al. (2) je definisao BSM kao implementaciju postupaka segregacije, sanitacije ili upravljanja koji su posebno usmereni na smanjenje verovatnoće unošenja, uspostavljanja, opstanka ili širenja potencijalnih

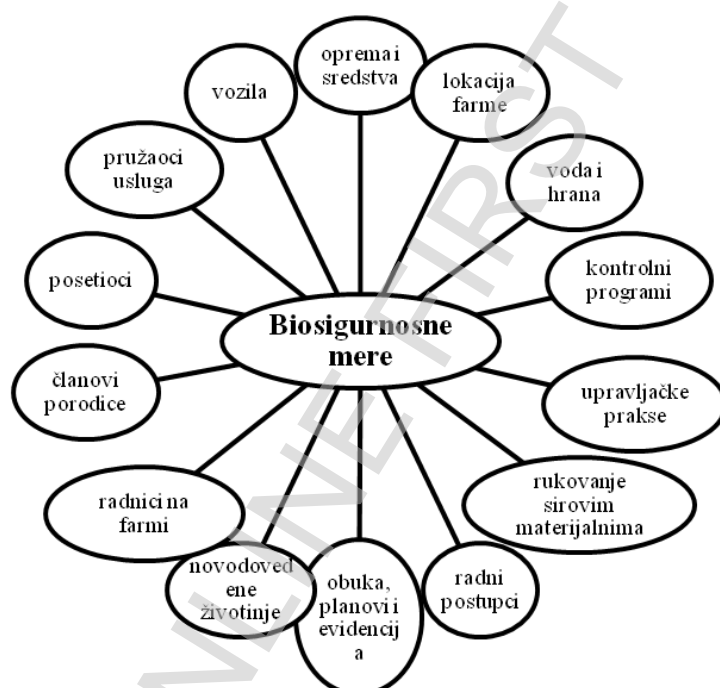
patogena u, unutar ili sa farme ili geografskog područja.

Cilj ovog rada je da se terenski veterinari i farmerii upoznaju sa najvažnijim merama biosigurnosti, odnosno suštinski najvažnijim opštim eksternim i internim BSM koje se odnose na lokaciju farme, novouvedene životinje, radnike na farmi, članove porodice, posetioce i pružaoce usluga, vozila, alate i opremu, vodu i hranu za životinje, programe kontrole, prakse upravljanja, rukovanja sirovim materijalima, procedure rada, obuku, planove i

evidenciju, što bi im sve pomoglo da prodube znanje i unaprede međusobnu saradnju.

Biosigurnosne mere

Na grafikonu 1 dat je prikaz biosigurnosnih mera koje se odnose na novodovedene životinje, radnike na farmi, članove porodice, posetioce i pružaoce usluga, vozila, alate i opremu, lokaciju farme, vodu i hranu za životinje, programe kontrole, prakse upravljanja, rukovanje sirovim materijalima, procedure rada, obuku, planove i evidenciju.



Grafikon 1. Biosigurnosne mere na farmama preživara

Uvođenje, izolacija i kretanje životinja

Za širenje bolesti važno je kretanje populacija domaćih i divljih životinja. Brojni nedavni primeri širenja bolesti su posledica kretanja domaćih ili divljih životinja. Razumevanje obima ovih kretanja i povezanih rizika je fundamentalno za razjašnjavanje epidemiologije bolesti, od kojih neke mogu predstavljati zoonotski rizik. Razmatran je značaj globalne trgovine životinjama i istaknuta je uloga neregulirane trgovine životinjama. Diskutovano je o brojnim ključnim primerima gde su kretanja životinja unela patogene u područja koja su ranije bila bez bolesti. Predlažu se mere zasnovane na pojačanom nadzoru za ublažavanje rizika od unošenja novih patogena (3). Važno je

razmotriti kontakte kod kretanja životinja između gazdinstava različitih tipova proizvodnje (4, 5), znanje, stav i praksu nomadskih i polunomadskih stočara (6, 7) i ulogu aukcijskih tržišta u kretanju životinja (8).

Brojna istraživanja su pokazala da uvođenje novih životinja na farmu i kretanje životinja (transport i reintrodukcija životinja) igra važnu ulogu u širenju bolesti (3, 8 - 11), zbog čega je održavanje stada bez nabavke životinja sa drugih farmi jedna od najvažnijih biosigurnosnih mera u prevenciji bolesti (3 - 5, 10, 12 - 15). Trgovina malim preživarama i njihovim proizvodima je od velikog značaja za biosigurnost, jer ovce i koze mogu da prenesu zoonotske bolesti, kao što su groznica doline Rift, Krimsko-Kongo hemoragična groznica,

bruceloza i listerioza (16). Stoga su procedure upravljanja koje se odnose na uvođenje novonabavljenih životinja i kretanje životinja na način da se minimizira rizik od unošenja ili širenja zaraznih bolesti od najveće važnosti.

Pregledni rad Mee et al. (15) razmatra dokaze za mnoge puteve prenošenja, kao što je unošenje infektivnih agenasa na farme muznih i tovnih goveda, do kojih može doći njihovim direktnim (kupljena goveda, ponovo uvedena goveda i kontakt sa susednim govedima) ili indirektnim prenošenjem (izmet, posetioci, druge vrste životinja i biološki materijal). U nedostatku programa iskorenjivanja mnogih endemskih zaraznih bolesti, bioisključivanje je najvažnija tehnika upravljanja za smanjenje biosigurnosnog rizika. Najveći rizik za unošenje infektivnih agenasa predstavlja nabavka životinja kada pridošle životinje imaju direktan kontakt sa stadom primaocem u dužem vremenskom periodu (11).

Kako novonabavljene životinje koje ulaze u farmu predstavljaju visok rizik od nenamernog unošenja patogena, neophodno je pre kupovine proveriti njihovo zdravstveno stanje. U prvom redu to znači da životinje treba kupovati samo sa farmi sa istim ili višim zdravstvenim statusom, zatim životinje ne treba kupovati iz stada u kojima se javljaju hromost, apscesi, patološke promene u ustima, lišaji, zamućenja očiju ili drugi klinički znaci bolesti, a takođe životinje namenjene za kupovinu treba pregledati, obraćajući posebnu pažnju na deformisane ili nedavno oštešene rožine papaka. Takođe treba voditi računa o tome da se životinje koje dolaze iz područja gde postoje poznati problemi sa helmintima otpornim na anthelmintska sredstva dehelmintišu i testiraju njihov feces pre dolaska u novo stado kako bi se osiguralo da se u stado ne unesu otporni paraziti (16 - 23).

Potrebno je vršiti segregaciju, posmatranje i po potrebi tretiranje novouvedenih životinja u karantinu, odnosno izolaciju u posebne prostore u zavisnosti od situacije, odvajanje karantinskih objekata od prostora u kome se drži ostatak stada, testiranje životinja na određene bolesti, karantin svih novopridošlih životinja na određeno vreme, a po mogućnosti do posle rođenja. Pored toga, novopridošle životinje moraju biti rutinski dehelmintisane i svi testovi na bolesti, tretmani, procedure i vakcinacije moraju biti završeni pre nego što životinje napuste izolaciju. Karantinski padoci ili torovi treba da budu smešteni što je moguće bliže ulazu na farmu ali dalje od drugih

životinja. Trebalo bi da postoji dvostruka ograda sa minimalnim rastojanjem od 3 metra između novopridošlih životinja i životinja na farmi. Uopšteno govoreći, farmeri treba da imaju na umu da je najbolje da uzgajaju što više životinja za remont stada na svojoj farmi i da nabavljaju nove životinje sa drugih farmi samo ako je neophodno (10, 18 - 24).

Prilikom transporta životinja na izložbe, sajmove i prodajna mesta, mora se imati u vidu da transportovane životinje mogu preneti uzročnike bolesti na druge životinje mešanjem ili kontaktom sa torovima, vozilima, ljudima i opremom. Da bi se sprečilo prenošenje bolesti na ovaj način, životinje ne smeju da napuštaju gazdinstvo dok za to ne dobiju saglasnost nadležnog veterinara. Takođe se mora obezbediti da sve životinje koje učestvuju na izložbi ili sajmove prođu obavezni veterinarski pregled pre istovara i da se životinje koje pokazuju znake bolesti po povratku ne istovaruju na farmu. Pored toga, treba obezbediti da životinje koje su se nedavno porodile ili su pobacile ili bi mogle da se porode u vreme izložbe budu isključene zbog rizika od prenošenja zaraznih abortivnih bolesti. Životinje treba prevoziti samo u vozilu koje je pre upotrebe očišćeno i dezinfikovano. Važno je izbegavati direktan kontakt sa drugim životinjama i ograničiti blizinu drugih životinja tokom transporta i na izložbama, sajmovima i prodajnim mestima. Farmer mora poneti prostirku i stočnu hranu sa farme i obezbediti snabdevanje čistom vodom na lokacijama izložbi, sajmovima i prodajnim mestima i doneti hranilice, kao i posude za vodu i opremu za čišćenje i rukovanje. Rukovanje domaćim životinjama od strane drugih lica mora biti ograničeno. Prilikom prevoza životinja koje se prodaju i preuzimaju sa farme treba voditi računa o dobrobiti životinja u skladu sa propisima o prevozu (18 - 24).

Poznavanje zdravstvenog statusa životinja koje se vraćaju na farmu (npr. životinje koje su učestvovala na izložbama, itd.) je od posebnog značaja za smanjenje rizika od unošenja i širenja bolesti u postojećem stadu. Imajući ovo na umu, mora se obezbediti da životinje koje se vraćaju na farmu budu odvojene na određeni vremenski period od matičnog stada, kako bi se procenila njihova podložnost infekciji. Pri tome treba uzeti u obzir higijenske mere i kontakt sa drugim životinjama tokom odsustva sa farme. Životinje koje se vraćaju na farmu treba zatim testirati u konsultaciji sa veterinarom pre (testovi za određivanje statusa bolesti mogu uključivati serologiju, kulturu i broj

fekalnih jaja). Životinje treba da ostanu u izolaciji dok rezultati testa ne budu dostupni. Tokom izolacije treba pratiti pojavu kliničkih znakova bolesti i napraviti plan za životinje sa pozitivnim rezultatima testa, koji obuhvata sprovođenje tretmana, zabranu ili odlaganje kupovine, nedeljenje objekata za hranjenje ili pojenje, obora, objekata za rukovanje ili opreme izolovanih životinja osim ako nisu prethodno očišćeni i dezinfikovani. Konačno, svi testovi otkrivanja bolesti, tretmani, procedure i vakcinacije treba da se završe pre nego što životinje napuste izolaciju (18 - 24).

Pri izolaciji i kontroli kretanja, takođe treba uzeti u obzir da farma bude okružena prirodnom barijerom ili ogradom, da je broj pristupnih tačaka farmi minimiziran, da je kretanje ljudi i vozila na i oko imanja svedeno na minimum, da nije dozvoljen kontakt sa životinjama iz drugih stada za vreme ispaše, da se preduzimaju mere za sprečavanje direktnog kontakta između životinja i divljači i na kraju da se preduzimaju mere za sprečavanje direktnog kontakta između preživara i drugih životinjskih vrsta (20 - 23).

Pored toga, treba imati na umu da se odrede "odobrene pristupne zone" za ugovorne strane izvođače na farmi (npr. veterinare, čuvar životinja, osoblja za veštačku oplodnju i dobavljače sena), vozila za isporuku i utovar životinja i sakupljanje proizvoda (npr. cisterne za mleko, kamioni za transport životinja i stočnu hranu) i uslužno osoblje (npr. tehničari za snabdevanje, službenici). Takođe, vozila za isporuku i utovar životinja i sakupljanje proizvoda (npr. cisterne za mleko, kamioni za transport životinja i stočnu hranu) i uslužno osoblje (npr. tehničari za snabdevanje, vladini službenici) treba da budu obeleženi i označeni po potrebi, a takođe bi trebalo da budu objekti obezbeđeni u "odobrenim pristupnim zonama" za izvođače na farmi i posetioce da očiste cipele i opremu po dolasku i pre odlaska sa farme (20 - 23).

U studijama biosigurnosti na farmama goveda u severozapadnoj Engleskoj, postojale su velike razlike između farmi u vrsti i obimu primene biosigurnosnih mera. Većina farmera nije vršila izolovanje kupljenih životinja, dok je mali broj farmera uvek vršio njihovu izolaciju. Mnogi farmeri su sprovodili tretmane nakon selidbe životinja, uglavnom vakcinacije i antihelmintsko tretiranje, ali vrlo mali broj farmera je prijavio da su izvršili zdravstvene preglede. Pored toga, činilo se da postoje velike varijacije u nivou biosigurnosnih mera koje sprovode različite kompanije i izvođači

koji su posetili farme. Kompanije za uklanjanje leševa i ugovoreni distributeri životinjskog otpada retko dezinfikuju sebe i svoja vozila, iako postoji velika verovatnoća kontakata sa infektivnim agensima. Ovi nalazi sugerišu da se, iako se sprovode određene prakse biosigurnosti, mnoge od njih retko ili nikada ne koriste. To može biti zbog mnogih faktora, uključujući troškove (vreme i novac), nedostatak dokazane efikasnosti biosigurnosnih praksi i nedostatak obuke veterinara, proizvođača i drugih stručnjaka odgovornih za zdravlje stada. Da bi stočarska proizvodnja u potpunosti koristila preventivnu medicinu, od suštinskog su značaja dalja istraživanja razloga za izostanak upotrebe biosigurnosnih praksi (25).

Radnici na farmi, članovi porodice, posetioci i pružaoci usluga

Osobe koje ulaze na farmu su uglavnom radnici na farmi, članovi porodice, posetioci i pružaoci usluga. Mora se osigurati da njihove aktivnosti i kretanje ne ugrožavaju zdravlje ljudi i životinja. Da bi se to osiguralo, radnici zaposleni na farmi moraju preduzimati mere biosigurnosti. Ovo uključuje osiguranje da svi radnici na farmi znaju i razumiju prakse biosigurnosti na farmi i da su voljni da ih implementiraju i prate promene biosigurnosnih planova i praksi. Pored toga, mora se obezbediti da u slučaju posete pružaoca usluga ili posetilaca, svi zaposleni na farmi budu obavešteni o tome. Brojne studije su pokazale da je ograničen pristup posetiocima biosigurnosna mera koja se često ne primenjuje (25 - 28).

Kretanje vlasnika, zaposlenih lica, posetilaca, veterinara i pružaoca usluga je uobičajeno na farmi i povećava rizik od unošenja i širenja bolesti. Mogu se razviti i primeniti mere za smanjenje ovih rizika. Pristup farmama treba ograničiti uspostavljanjem različitih zona sa različitim nivoima zaštite. Ove zone treba da budu označene granicama i odgovarajućom signalizacijom. Kretanje ljudi u određenu zonu, van određene zone i između određenih zona može se kontrolisati korišćenjem kontrolisanih pristupnih tačaka (22, 23).

Postoji nekoliko važnih principa biosigurnosti koje treba poštovati što je više moguće, a to su: osoblje je isključivo angažovano na farmi (tj. ne deli se sa drugim farmama), posetioci koji ne moraju nužno da dođu u kontakt sa životinjama, kao npr. prodavci, konsultanti, itd., ne

smeju da imaju kontakt sa životinjama, posetiocima koji apsolutno moraju da dođu u kontakt sa životinjama, kao što su veterinari, osoblje za šišanje, obezivači papaka, itd., obezbeđuju se čizme/prekrivači za cipele i kombinezoni na farmi, dezinfekcione barijere za nogu na ulazu u prostorije, definišu se i postavljaju bisigurnosni znaci gde je to potrebno, obezbeđuje se osmišljen rad na farmi na taj način da minimizira kretanje ljudi, vozila ili opreme u prostore u kojima se drže životinje i vodi se evidencija o posetiocima farme (19).

Svi posetioci i pružaoci usluga moraju biti svesni i pripremljeni za primenu biosigurnosnih mera pre posete. Po ulasku na farmu, svi posetioci i pružaoci usluga moraju da se upišu u registar posetilaca. Nakon registracije, svi oni koji ulaze, rade ili posećuju farmu moraju da operu i dezinfikuju ruke pri ulasku i izlasku sa farme, kada se kreću između pojedinih segmenata i kada ulaze ili izlaze iz određenih rizičnih zona u prostorijama, kao što su prostorije za izolaciju ili tretiranje životinja. Ruke takođe treba oprati ili dezinfikovati pre i posle bilo kakvog kontakta sa životinjama, posebno bolesnim ili životinjama nepoznatog zdravstvenog statusa, kao i nakon kontakta sa potencijalno kontaminiranim materijalima kao što su mrtve životinje, pobačeni fetusi, posteljica ili stajnjak (18, 21 - 24).

Nakon pranja ruku na ulazu, posetioci i pružaoci usluga moraju biti obavješteni o rasporedu prostora na farmi, u kojim prostorima im je dozvoljen pristup i koje biosigurnosne prakse treba da primenjuju na toj lokaciji. Pri tome je potrebno obezbediti da posetioci i pružaoci usluga pristupaju samo delovima farme koji su im neophodni i da im se dozvoli kontakt sa životinjama samo kada je to neophodno. Od velike je važnosti podsticati upotrebu lične zaštitne opreme kada posetioci i pružaoci usluga uđu na imanje farme. Takođe, posetiocima i pružaocima usluga treba objasniti upotrebu lične zaštitne opreme, način odlaganja posle upotrebe (20 - 23).

Pored toga, ne treba zaboraviti sastanke sa radnicima na farmi i članovima njihovih porodica najmanje dva puta godišnje kako bi se razgovaralo o prednostima i efikasnosti svake prakse iz plana biosigurnosti. Na takvim sastancima može se razgovarati o osnovnim temama kao što je napuštanje prostora za životinje bez čišćenja odeće od zagađivača kao što je životinjski izmet ili napuštanje prostora za životinje bez čišćenja i dezinfekcije obuće (19, 22, 23).

Vozila, alati i oprema

Jasno je da bi bilo teško kontrolisati i pratiti širenje bolesti bez ograničenja parkiranja i kretanja vozila unutar površina farme. Biosigurnosne mere predviđaju da vozila koja se kreću od farme do farme mogu da uđu na farmu samo ako su očišćena i dezinfikovana na način da bilo kakva kontaminacija donjih delova ili spoljašnjosti vozila ne može da uđe na farmu. Treba imati u vidu da više neobezbeđenih ulaza na farmu otežava praćenje i kontrolu ulaska vozila na području farme. Stoga, za ulazak u farmu treba koristiti samo jedan ili dva kontrolisana ulaza.

Vozila za prevoz životinja treba da vrše utovarivanje i istovarivanje na perimetru farme, a životinje se zatim mogu odvesti u zonu izolacije. Vozila za stočnu hranu takođe treba da budu istovarena ili utovarena na određenim mestima, po mogućstvu blizu ispusta za hranu, bez ulaska u glavni deo farme. Treba osigurati da se kamioni koji se koriste za transport stočne hrane ili silaže ne koriste u svrhe koje predstavljaju biosigurnosni rizik za stado i da se pre upotrebe na odgovarajući način očiste i dezinfikuju (20 - 24).

U suštini, kada se prevoze preživari, biraju se samo zdrave životinje koje su u stanju da podnesu utovar kako bi se minimiziralo potencijalno širenje bolesti i/ili kontaminacije putem transporta, transportnim vozilima, hranom, zaliham, sredstvima za održavanje itd. Vozilima je dozvoljen ulazak i napuštanje prostora farme samo ako su propisno dezinfikovani. Transportna vozila za odvoženje životinja i hrane (na klanje, skladišta stočne hrane i sl.) treba da dolaze na farmu prazna (tj. bez drugih životinja), očišćena i dezinfikovana. Posebno treba voditi računa da se uginule životinje i/ili životinjski materijali prikupljaju vozilom za kafileriju i da to vozilo može ukloniti mrtve životinje bez ulaska u prostore farme (20 - 23).

Čišćenje i dezinfekcija je najvažniji alat biosigurnosti za smanjenje rizika od bolesti koje se prenose vozilima. Za vozila koja moraju ući u prostorije farme treba obezbediti prostor za pranje. Ako je moguće, treba koristiti sistem za čišćenje i pranje vozila i opreme pod visokim pritiskom, udaljeno od useva i životinja. Takođe se mora obezbediti da se otpadna voda iz postrojenja za pranje preusmeri sa proizvodnih površina farme. Ako nije moguće obezbediti prostor za pranje, mora se obezbediti da vozila koja ulaze na farmu prolaze kroz postrojenje za pranje točkova, koje je

postavljeno na ulazu u farmu. Na kraju, važno je voditi evidenciju vozila u koju su uredno upisani svi potrebni podaci prilikom ulaska i izlaska iz farme (20 - 24).

Rizik od širenja bolesti je veći kada se oprema pozajmljuje od drugih farmi, pozajmljuje drugim farmama ili kupuje polovna od drugih farmera. Mora se obezbediti da kretanje i korišćenje opreme i mašina ni na koji način ne ugrožava zdravlje ljudi i životinja, ne samo u okviru farme već i na drugim farmama u blizini. Najbolje je svesti na minimum pozajmljivanje opreme između farmi. Ako se oprema pozajmljuje, treba se pobrinuti da se očisti pre i posle upotrebe. Takođe je potrebno obezbediti specijalne alate, odeću i obuću za određene prostore kao što su proizvodni prostori ili izolacioni prostori u kojima se drže bolesne životinje ili životinje u karantinu. Čišćenje i dezinfekcija igala, alata itd., između svake upotrebe, a posebno između upotrebe u različitim stadima je od najveće važnosti (20 - 22).

Lokacija farme

Rizik od bolesti se višestruko povećava ako se farma nalazi u blizini drugih farmi, klanica, stočnih pijaca, objekata za odlaganje otpada i kafilerija (20 - 22). Lokacija farme u blizini puteva za prevoz životinja i plovnih puteva takođe povećava rizik. Orijentaciju štala, zgrada, ventilacionih ulaznih i izlaznih otvora, prostorija za istovar i utovar, prostorija za tretman i izolaciju ili karantinskih stanica treba birati na taj način da se minimizira rizik od unošenja i širenja bolesti (20 - 22). Odvojeni prostori za uzgoj mladih, bolesnih i novonabavljeni životinja sa vidljivo razgraničenim područjima smanjuju rizik od prenošenja bolesti. Prirodne karakteristike kao što su vegetacija, vodotokovi i topografija mogu biti od koristi u planu biosigurnosti jer pružaju prirodne barijere i mogućnosti drenaže (22, 23).

Hrana i voda

Hrana za životinje može biti izvor kontaminacije, infekcije i može da nosi ili sadrži patogene, hemijske ostatke, seme korova i štetočine. Nepravilno uskladištena hrana se takođe može pokvariti, razviti neželjene patogene (npr. plesni) ili biti kontaminirana štetočinama (11, 22, 23). Važne mere biosigurnosti uključuju nabavku stočne hrane od pouzdanih dobavljača koji vode računa o higijeni i kvalitetu, poštuju propise za hranu koja služi za ishranu preživara i obezbeđuju da se ona

transportuje čistim prevoznim sredstvima (20, 22). Mora se osigurati da se hrana istovaruje tek nakon inspekcije na prisustvo štetočina, oštećenja i kontaminacije. Potrebno je proveriti hranu za preživare uzimanjem uzoraka hrane iz svake dospele serije. Pored toga, hrana za preživare mora biti obeležena i uskladištena na način da se kasnije može ispitati na kvalitet i, ako je potrebno, na prisustvo toksina. Treba skladištiti stočnu hranu na način da se izbegne kontaminacija od štetočina, divljih životinja i domaćih životinja i druge hrane za životinje. Izuzetno je važno obezbediti da se preživari ne hrane proizvodima dobijenim od kičmenjaka, sa izuzetkom loja i želatina. Prilikom snabdevanja vodom mora se voditi računa o tome da njena količina i kvalitet odgovara vrsti preživara. Kvalitet vode za piće za preživare treba da se proverava najmanje jednom godišnje bakteriološkom analizom. Redovno ispitivanje vode, zemljišta, stočne hrane i silaže je veoma važno kada se sprovodi plan biosigurnosti na nivou farme (22). Izvori vode koji su kontaminirani izmetom ili urinom mogu izložiti životinje patogenima zbog čega ih treba ih redovno čistiti. Stajnjak i nečista voda mogu dugo predstavljati biosigurnosni opasnost jer *Escherichia coli* O157, *Salmonella* i *Campilobacter* mogu da prežive u njima do 3 meseca (29).

Kontrolni program

Programi kontrole su veoma značajni elementi biosigurnosti na farmama preživara (20 - 23). Oni uključuju pisane protokole za higijenske procedure, programe vakcinacije za bolesti koje preporučuje licencirani veterinar (najčešće protiv klostridijalnih bolesti: *Clostridium perfringens* tipovi C i D i tetanusa, tetanusa, kazeoznog limfadenitisa, vibrio i hlamidijalnog abortusa, epididimitisa i zarazne šepavosti), programe kontrole parazita koji kombinuju prakse upravljanja sa ciljanom selektivnom dehelmintizacijom, programe kontrole glodara, programe kontrole insekata, programe kontrole ptica, kao i obezbeđivanje kontrole za potencijalno širenje bolesti preko leševa i otpadnih voda. Leševi služe kao rezervoari za patogene, privlače štetočine i izvor su za prenošenje patogena. Različite metode odlaganja leševa, uključujući zakopavanje, deponovanje, spaljivanje, reciklažu, kompostiranje i alkalnu hidrolizu, pregledno su prikazani od strane su (30).

Prakse upravljanja

Prakse upravljanja su takođe suštinski elementi biosigurnosti na farmama preživara (21 - 23). One uključuju sistem za identifikaciju i sledljivost životinja, veterinarsku inspekciju prostora za teljenje, jagnjenje i jarenje - najmanje godišnje jednom, čišćenje i dezinfekciju materijala koji se koriste za ishranu teladi/jagnjadi/jaradi (kolostrum, mleko, itd.) nakon rođenja, odvojene prostore od porodilišta i karantina za bolesne životinje (prostori za tretman) koji se obavezno čiste i dezinfikuju nakon svake upotrebe. Pored toga, životinje koje su abortirale se testiraju na bolesti koje se ne prijavljuju, sperma treba da se nabavlja iz renomiranih izvora, primena otpadnih voda i stajnjaka, posebno visokorizičnih vrsta, treba da bude regulisana na način da bi se minimiziralo širenje bolesti kroz kontaminaciju pašnjaka, hrane i vode, a štetocine, divlje životinje, korov i populacije divljih životinja treba da se prate i regulišu kako bi se sprečio uticaj na preživare (20 - 24).

Radne rutine

Često se dešavaju nepreciznosti prilikom sprovođenja svakodnevnih radnih rutina, koje predstavljaju važne biosigurnosne mere. To uključuje redovnu inspekciju životinja radi ranog otkrivanja bolesnih životinja, radne rutine za osoblje farme (npr. treba uspostaviti radne procedure za kretanje osoblja na farmi od mlađih ka starijim životinjama), zatim materijal za prostirku treba da bude odgovarajući, otpadne vode treba da budu sakupljane i zadržane na način koji bi omogućio sprečavanje pristupa ljudi i životinja, leševi i otpadne materije treba da budu odloženi što je pre moguće, uzimajući u obzir ekološke i javne aspekte, mesta za odlaganje treba da budu odabrana na način da se izbegne potencijalno širenje zagađivača, mesta za odlaganje treba da budu obezbeđena na taj način da bi se sprečio pristup domaćim i divljim životinjama, i na kraju, trebalo bi sprovoditi redovne inspekcije farme kako bi se procenila potencijalna kršenja biosigurnosti (20 - 23).

Obuka, planiranje i evidencija

Planiranje i evidentiranje sprovođenja biosigurnosnih mera omogućava njihovu sistematsku primenu. U tom smislu, obuka farmera

je izuzetno važna. Zbog toga se za farmu mora izraditi plan biosigurnosti koji uključuje obuku, planiranje i evidenciju. Osoblje treba u potpunosti da razume svoju ulogu u primeni biosigurnosnih praksi na farmi kroz uvod u plan upravljanja biosigurnošću, stalnu obuku o biosigurnosti i redovnu reviziju protokola o biosigurnosti na farmi. Od izuzetne je važnosti da osoblje zaduženo za stočarsku proizvodnju zna kako da identifikuje bolesne i povređene preživare i šta da radi kada se sumnja na bolest životinja. Konačno, osoblje treba da zna gde da pronađe kontaktne podatke lokalnih veterinarara i relevantnih vladinih zvaničnika (20 - 23).

Razmatranje biosigurnosnih mera

U literaturi se susreću različite studije o upotrebi biosigurnosnih mera kod preživara, kao što su faktori koji utiču na njihovo korišćenje za zaštitu preživara i radnika na farmama od zaraznih bolesti (31), evaluacija biosigurnosnih praksi u proizvodnji, marketingu i za vreme klanja goveda, ovaca i koza (32) i korišćenje upitnika za procenu biosigurnosti u finskim farmama goveda, svinja i ovaca (26). Razmatrane su brojne teme u vezi sa biosigurnošću goveda, kao što su: biosigurnost na farmama goveda (25, 33), osnove biosigurnosti na farmama goveda i dobre prakse upravljanja za suzbijanje zaraznih bolesti (34), pokretači zajedničkih biosigurnosnih mera kod goveda i ovaca (35), standardi biosigurnosti na farmama goveda (36), biosigurnost i prakse upravljanja na odabranim belgijskim farmama goveda (27). Prakse biosigurnosti na farmama muznih krava opisane su u brojnim zemljama kao što su Brazil (37), Australija (38), Irska (10) i Kanada (39). Pored toga, razmotreni su aspekti biosigurnosti, zdravlja i uklanjanja grla u rastućim mlečnim stadima (40), kao i biosigurnost u vezi sa gastrointestinalnim bolestima kod muznih krava (12). Biosigurnost i upravljanje (13), zatim biosigurnost i upravljanje kod izbivanja bolesti životinja (28), bioekskluzija, biosigurnost i bezbednosne prakse (41) i bioisključivanje bolesti na farmama muznih i tovnih goveda (15) su teme koje su često razmatrane u vezi sa biosigurnošću na farmama pomenutih preživara.

Brojni radovi ukazuju na značaj primene BSM na nivou farme u očuvanju zdravlja preživara na različitim farmama (15, 35, 40 - 45). Pored zdravlja preživara, primena BSM na farmama preživara je veoma važna za prevenciju zoonoza (46, 47, 48, 49, 50). U literaturi se naglašava da je većina

agenasa bioterorizma zoonotskog porekla i da bi životinje mogle da posluže kao rano upozorenje ljudima ako se klinički znaci kod njih otkriju pre početka pojave bolesti kod ljudi ili dovoljno rano da se započnu preventivne mere (51).

Studije u Ujedinjenom Kraljevstvu (UK) pokazale su da farmeri i veterinari imaju svoje relativno jasne definicije biosigurnosti u odnosu na neke ključne bolesti koje prete stočarstvu UK. Farmeri smatraju da bi drugi akteri, kao što je vlada, trebalo da imaju veći uticaj na biosigurnost u Velikoj Britaniji. Nasuprot tome, veterinari su kao glavnu prepreku videli sposobnost ili spremnost svojih klijenata da ulažu u biosigurnosne mere. Veterinari su takođe smatrali da su potrebni dodatni dokazi o efikasnosti i/ili bolji dokazi o potencijalnim ekonomskim koristima predloženih biosigurnosnih mera na farmi. Pomoćne industrije generalno nisu bile sigurne u svoju ulogu u biosigurnosti, iako su učesnici studije istakli zoonoze kao deo problema i ukazali da većina prepreka postoji na nivou farme (45).

Studije o biosigurnosti farme, kako ih vide profesionalci koji posećuju švedske farme, otkrile su mnoge prepreke, posebno na farmama ovaca i koza. U osnovi, posetioци smatraju da uslovi na farmama ne dozvoljavaju adekvatan nivo biosigurnosti i da mnogi farmer ne primenjuju biosigurnosne mere, dok farmeri očekuju da se svi posetioци ponašaju profesionalno i da preuzmu odgovornost za neširenje bolesti (52).

Studije o percepciji i praksi veterinaru u ruralnim područjima u vezi sa biosigurnošću u tri evropske zemlje otkrile su različite prednosti, slabosti, moguća ograničenja i rešenja u pogledu veterinarske perspektive biosigurnosti. Farmeri smatraju veterinare ključnim osobama koje pružaju informacije, stoga bi oni mogli igrati aktivniju ulogu u savetovanju i poboljšanju biosigurnosti na nivou farme. Na osnovu rezultata istraživanja, pokazalo se da dva faktora značajno utiču na nivo sprovođenja mera: zemlja u kojoj veterinar radi i percepcija veterinaru o biosigurnosti. Nivoi biosigurnosti sa najnižim nivoom implementacije, a samim tim i najvećim rizikom, bili su biosigurnosno ograničenje i biosigurnosna kontrola (53). Podrazumeva se da je potrebno dobro poznavanje veterinarske epidemiologije da bi se razvili programi kontrole bolesti i sproveli programi biosigurnosti na farmama na regionalnom i nacionalnom nivou (54).

Farmeri imaju značajnu ulogu u sprovođenju biosigurnosnih mera. Istraživanja o primeni rutina

koje doprinose biosigurnosti na farmama pokazala su da se na farmama goveda, ovaca, koza i mešanih vrsta primenjuju niži nivoi mera biosigurnosti nego na farmama svinja (14). Proces učenja o biosigurnosti i faktorima koji utiču na njegovu primenu od strane farmera vezan je za suštinu promene ljudskog ponašanja. Da bi se došlo do efikasne promene u trenutnim biosigurnosnim praksama, savetnici i menadžeri farmi moraju da razumeju šta motiviše i utiče na radnike da primenjuju biosigurnost (42). Poznavanje uticaja ljudskog delovanja na rizik od zaraznih bolesti (43), mišljenja i prakse farmera u vezi sa biosigurnošću i dobrobiti životinja (44), determinantama biosigurnosnog ponašanja farmera u smislu ekonomske analize (55).) su veoma značajni aspekti.

Različiti aspekti biosigurnosti ovaca i koza opisani su u publikacijama o biosigurnosnom statusu farmi malih preživara (56), odnosu između strukturalnih karakteristika i biosigurnosti na farmi ovaca (57) i implementaciji biosigurnosti na farmama malih preživara (58). Različite publikacije dalje opisuju najbolje prakse upravljanja za farmere mlečnih koza (59), biosigurnost na farmama ovaca (20), planiranje biosigurnosti za proizvođače koza (60), biosigurnost za koze (61), biosigurnost za proizvođače ovaca i koza (24), planiranje biosigurnosti za proizvođače ovaca (22) i biosigurnost u vezi sa proizvodnjom životinja na ispaši (23).

Mešoviti stočarski sistemi su uobičajeni u zemljama u razvoju. Veoma ilustrativan primer primene biosigurnosnih mera u ovim sistemima je studija koja je obuhvatila farmere u Australiji (38). Rezultati ove studije su pokazali da je 69% farmi ima mešoviti stočarski sistem, pri čemu većina farmi drži ovce i mlečna goveda na istom imanju. Oko polovine farmi (49%) nije obezbedilo formalnu obuku o aspektima zdravlja životinja za novozaposlene i nije pratilo zdravlje bikova. Većina farmi (98%) zahtevala je od svojih zaposlenih lica da nose ličnu zaštitnu opremu kao što su kombinezoni i čizme, ali samo nekoliko farmi (34%) je imalo određene prostore za čišćenje obuće i sistem za evidentiranje posetilaca (17%). Većina farmi je vodila evidenciju o zdravlju životinja, održavanju ograde i korišćenju obrazaca za deklaracije dobavljača. Praksa stavljanja novih životinja u karantin pre njihovog dovođenja u kontakt sa drugim životinjama korišćena je samo na

45% farmi, a na 55% farmi su obavljane mesečne zdravstvene posete veterinara.

BSM su posebno važni u "otvorenim" stadima u kojima preživari dolaze u kontakt sa životinjama iz drugih farmi (kupovina priplodnih životinja, učešće na stočarskim izložbama, zajedničkim pašnjacima, itd.), gde su strožije mere biosigurnosti (tj. izolacija novonabavljenih životinja, klinički pregledi, laboratorijske pretrage, vakcinacije i sl.) nego u zatvorenim stadima (33).

Rizici od unošenja i efekti biosigurnosnih mera varirali su u zavisnosti od tipa farme i načina prenošenja bolesti. Prilagođavanje obrazaca kontakata da bi se ublažio određeni rizik od bolesti bilo je jednako važno kao i biosigurnosne mere za neke tipove farmi, ali najveći efekat je primećen kada su biosigurnosne mere kombinovane sa bolje planiranim obrascima kontakata. Model procene rizika pokazao se korisnim za ilustraciju rizika od unošenja endemskih bolesti i ublažavanja efekata različitih biosigurnosnih mera na nivou farme (62).

Unakrsna studija mešovitih metoda u Keniji, koja je uključivala 26 diskusija fokusnih grupa sa članovima zajednice i 10 opservacionih intervju sa osobljem klanice, istraživanje domaćinstava sa 560 članova zajednice i odvojeno istraživanje 231 trgovca životinjama, otkrila je da su proizvođači, trgovci i osoblje klanice sprovodili neke biosigurnosne prakse, ali ne i sve. U studiji je zaključeno da je sprovođenje biosigurnosnih mera u ruralnim područjima složenije od strategija i okvira biosigurnosti koji su propisani. Takođe je pokazala da ograničenje resursa, loša implementacija i kulturne prakse mogu ovo ometati. Preporučuje se sprovođenje daljih studija o spremnosti da se usvoje biosigurnosne mere usmerene na članove zajednice u oblastima sa siromašnim resursima kako bi se identifikovale moguće kritične tačke za intervencije na nivou okruga i države (32).

Studija biosigurnosne prakse stada goveda u zapadnoj Kanadi koju su uradili Vennekamp et al. (39) je otkrila da su kod 54% stada kupovane junice, a kod 42% krave. Upotreba standardnih praksi biosigurnosti je generalno bila niska: 30% proizvođača je držalo kupljene životinje odvojeno, a 30% novonabavljenih životinja je vakcinisano. Nijedna od procenjenih biosigurnosnih praksi nije

bila povezana sa prijavljivanjem Joneove bolesti. Nabavka više od 10 bikova, nabavka krava, nevakcinisanih kupljenih životinja i korišćenje zajedničkih pašnjaka povezivani su sa izbijanjem respiratornih bolesti goveda. Izbijanje dijareje kod teladi bilo je povezano sa kupovinom 10 ili više bikova, korišćenja zajedničkih pašnjaka i iznajmljivanja ili deljenja bikova.

Neophodno je redovno procenjivati sprovođenje biosigurnosnih mera korišćenjem odgovarajućih upitnika (14, 26, 27, 52, 63). Za procenu biosigurnosti mlečnih goveda, tovnih junadi, teladi, mlečnih i tovnih malih preživara mogu se koristiti upitnici Univerziteta u Gentu (videti link Biocheck ugent: <https://biocheckgent.com/en/surveis>), koji mogu istaći nedostatke koje treba odmah otkloniti. Za procenu uspešnosti primene biosigurnosnih mera, procena rizika je veoma važna kao alat za poboljšanje eksterne biosigurnosti (62). Pregled metoda koje se koriste za procenu biološkog rizika na farmama mleka nalazi se u radu Stanković i sar. (64), priručniku za biosigurnost (1) i smernicama za analizu rizika kod uvoza (65).

ZAKLJUČAK

Veoma je važno primeniti biosigurnosne principe i mere kao dugogodišnje i uspešne prakse na farmama kako bi preživari bili zdravi. Ovi principi i mere treba da budu uključeni u sveobuhvatni plan biosigurnosti. Plan biosigurnosti treba da se bavi načinom na koji farmeri postupaju sa životinjama, vozilima i pristupom ljudi na farmi, zdravljem životinja i brojnim drugim aktivnostima. Najvažnije principe biosigurnosti treba pratiti kontinuirano, a u saradnji sa državnim službenicima i veterinarima, farmeri omogućavaju sebi da igraju značajnu ulogu u održavanju što je moguće zdravije životinje i proizvodnju.

Acknowledgments

Ova publikacija je zasnovana na radu iz COST akcije CA20103, "Biosecurity enhanced through training evaluation and raising awareness (BETTER)," uz podršku Evropske saradnje u nauci i tehnologiji (COST).

REFERENCE

Reference su identične kao u engleskom prevodu rada.