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What is a “good” website for communicating biosecurity information to farmers and veterinarians?

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ABSTRACT

Although many websites provide biosecurity information, there is no structured guidance on what constitutes an effective biosecurity website. This study aimed to understand what is a good biosecurity website for farmers and veterinarians, and to what extent different websites meet the proposed good features. The study included three steps: i) A World Café activity was conducted to identify the features of a “good” biosecurity website. ii) A sample of biosecurity websites was identified through an online survey and generative artificial intelligence and then screened by researchers. iii) The main improvement needs of biosecurity websites were detected by comparing the screened websites with the features of a “good” biosecurity website.

Based on the World Café, the features of a good biosecurity website targeted to farmers were ease of use, cost-free access, availability in local languages and content including, for example, biosecurity lessons with media, examples of farm practices, biosecurity guidelines, self-evaluation tests of person’s knowledge and farm’s biosecurity level, and news about disease outbreaks and regulations. A good website for veterinarians should contain more detailed protocols, guidelines and tools than a website for farmers, and resources for creating biosecurity plans and enhancing veterinarian-farmer communication. The depth and breadth of information available on the screened websites varied. Most websites had a limited number of “good” features present. The comparison step suggested that the greatest improvement potential among the websites was in adding information on how to communicate about biosecurity, biosecurity’s costs and benefits, self-evaluation tests, and videos and illustrations about biosecurity measures.

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1. Introduction

Increased density of production facilities, animals, or contacts between them contribute to the spread of infectious diseases, leading to higher rates of infections, death, and economic losses (VanderWaal and Deen, 2018; Rohr et al., 2019). Increasing wildlife–livestock interactions also raise opportunities for pathogen transmission and biodiversity erosion (Ferran et al., 2021). The Animal Health Law (AHL) of the European Union (European Parliament and the Council, 2016) emphasizes disease prevention through biosecurity, surveillance, and traceability, defining biosecurity as the management and physical measures designed to reduce the risk of disease spread within animal populations. Effective biosecurity interventions and education are crucial in these efforts, and veterinarians are key persons in promoting good biosecurity practices.

In the big data era, the Internet is a valuable source of information: it is easy to access and continuously available, and information can often be accessed at low cost. The amount of information from a multitude of different online sources may be overwhelming, especially for non-expert users. In addition, users must be cautious about the quality and validity of information on the Internet, especially when generative artificial intelligence (AI), which might hallucinate (see Qian et al., 2025) or omit information, is used (Zaretsky et al., 2024).

While farmers utilize online resources and external advice to increase their biosecurity awareness, they often still rely on their individual farming experience to manage animal disease risks (Agrawal et al., 2023). The lack of biosecurity information is a challenge for veterinarians, farmers, and other farm workers (Marić et al., 2024; Saegerman et al., 2024). Hence, there is a need for a centralised online source of information, a webpage (McKimm et al., 2003; Robles, 2013), that defines the protective measures for animals in an easily understandable way, indicates the impact of deficiencies in biosecurity, satisfies key actors' curiosity, and helps them to improve their overall knowledge on farm biosecurity (Saegerman et al., 2024; Morris et al., 2023; Huber et al., 2022).

A website is a collection of interconnected webpages hosted on a web server, accessible through the Internet. It is a digital platform used to present information, provide services, or facilitate communication and interaction between individuals, businesses, organizations, and other entities (McKimm et al., 2003; Robles, 2013). When defining what constitutes a “good” website in general, a multitude of factors such as aesthetic design, user-friendliness, and the quality, quantity, and relevance of the website's content, can be considered (Garett et al., 2016; McKimm et al., 2003). Sufficient, relevant, and well-organized content can attract repeat visitors and sustain their engagement (Fundingsland et al., 2022). Additionally, the content should be presented in a way that motivates and engages users, with a clear understanding of the site's purpose and the visitors' needs (Garett et al., 2016; Reinecke and Gajos, 2014). In general, a good website has a clear and distinct identity or brand that addresses visitors' intentions for accessing the site and provides information about the organization or services it represents. Simplicity is another general hallmark of an effective website design. This can be achieved, for example, through simple and intuitive subject headings, a transparent and uncluttered layout, consistent design across the site, and ease of use (McKimm et al., 2003; Reinecke and Gajos, 2014; Garrett et al., 2016).

A well-structured, up-to-date, and user-friendly biosecurity website can help in preventing the introduction and the spread of diseases, improving animal health, and increasing agricultural productivity by enhancing veterinarians', farmers', and farm workers' knowledge on biosecurity. Some features of a good biosecurity website are generic and some are dependent on the substance topic and the target audience. According to the authors' knowledge, no scientific article has discussed the criteria of a good biosecurity website design and the necessary contents of such a website. Furthermore, there are no data describing the specific needs and expectations of farmers and veterinarians. The aim of this study was to gain an understanding of what are the features of a

‘good’ biosecurity website for farmers and veterinarians and to what extent certain websites meet the proposed features. Moreover, the overall potential for improving a sample of biosecurity websites was addressed. The next section presents the data and methods employed by the study, and subsequent sections present results, conclusions, and recommendations.

2. Material and methods

2.1. Outline

Our research approach included three steps. First, the World Café method was used to identify what is required for a good biosecurity website. Second, existing biosecurity websites were identified by a survey and generative artificial intelligence, and then screened. Third, the features of existing websites were compared with the desirable features that were identified by the World Café to elaborate overall development needs of biosecurity websites.

2.2. The World Café method

2.2.1. Presentation of the method

The World Café method is a participatory tool that enables capturing the views of many people and facilitates the use of these ideas to promote changes. Therefore, it was considered a useful method to collect information about the features of a good website. The method draws upon the café ambience created to enable informal and engaging conversation in a neutral space and cross-pollination of ideas while discussing a specific topic (Brown and Isaacs, 2005). It has been used in different settings, such as research prioritization (MacFarlane et al., 2017), plant and public health programme evaluation and planning (MacLeod et al., 2016; MacFarlane et al., 2017; Silva and Guenther, 2018), and animal health (Jori et al., 2020).

A World Café discussion engages small groups in meaningful conversations around a set of predefined topics. Each conversation is guided by a facilitator and documented by a reporter, ensuring structured and productive dialogue (Löhr et al., 2020). Participants rotate between topics once the allocated discussion time has elapsed (Fig. 1). Progress is striven for at each rotation, supported by the facilitator who gives a short introduction at the start of each conversation to inform the participants about the topic and the contributions of previous groups (Carson, 2011). This structured facilitation process helps ensure a coherent flow of ideas, enabling participants to build upon prior insights and engage in deeper dialogue (Takahashi et al., 2014; MacFarlane et al., 2017).

The method has seven integrated principles, namely i) setting the context, ii) creating a hospitable space, iii) exploring questions that matter to the participants, iv) encouraging all participants to contribute, v) cross-pollinating and connecting different views, vi) listening together for patterns, insights, and further questions, and vii) gathering and sharing collective findings (Brown and Isaacs, 2005, p. 40).

2.2.2. Study design and participant selection

The World Café was conducted on the 6th of February 2024 at the University of Padua, Italy, during the BETTER COST action² meeting. The participants of the group discussion ($N = 67$) were academics, PhD students, veterinarians with different expertise, stakeholder representatives, and livestock sector experts from 25 European countries (Appendix 1). The majority of participants had a background in veterinary medicine. Some participants had a background in agricultural or social sciences.

Before the World Café, the principles of the method, the topics of

² Biosecurity Enhanced Through Training Evaluation and Raising Awareness (BETTER), CA20103. <https://better-biosecurity.eu/>

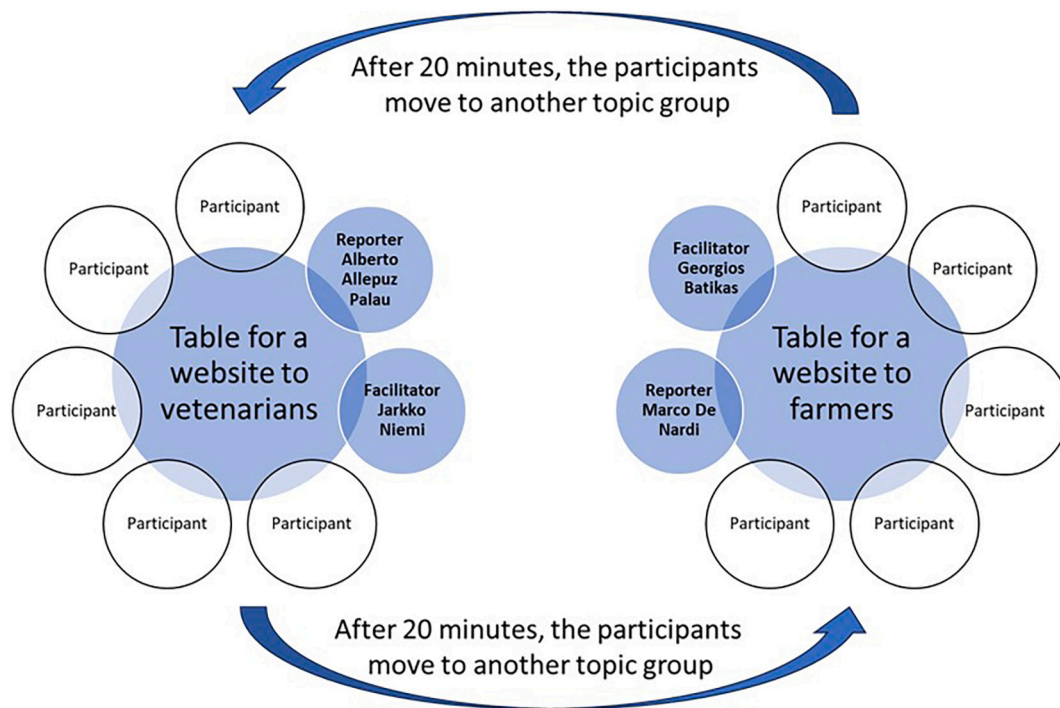


Fig. 1. The setup of World Café tables focussing on a biosecurity website.

discussion groups, and the purpose of data collection were introduced to the participants. The meeting participants then decided whether they wanted to voluntarily take part in the group discussion (an informed consent) or if they opted out. The participants were allowed to exit the discussion at any time, and they could choose not to respond to questions presented to them. The participants were assigned to one of four groups according to their own choice, and each group spent 20 min at one table and then moved to another table. Therefore, each topic was discussed for at least 80 min. At the end, each group was asked to vote for the 3–5 most important topics of their discussion.

The World Café had two discussion tables relevant for this study. One group discussed the features of a website for veterinarians and another for farmers. Discussions on the following questions were initiated at both tables: i) What should be the objectives of a biosecurity website for farmers/veterinarians? ii) What topics should be covered? iii) What species should be considered? iv) What type of access to the website is preferred? After the initial questions, the discussion evolved according to the points raised by each group. After the World Café, the facilitator and the reporter summarised the results. Finally, the results of the two tables were integrated and compared. A feature was considered to be “needed” on a website, if the World Café participants collectively pointed this out. Otherwise, it was considered not to be needed. For some topics, the participants suggested whether detailed or simplified and easy-to-understand information should be provided on the website.

2.3. Website data collection

In this study, a biosecurity website was defined as a website that includes *contextual information* that could be used to guide farm biosecurity measures. The sample of websites analysed in the study was identified in two ways: i) by using data from an online survey that enquired about biosecurity projects and trainings, and ii) by using artificial intelligence (ChatGPT 3.5 (OpenAI, 2023) to specifically identify biosecurity websites.

The online survey (QuestionPro. Inc., TX, USA) was prepared by a working group, then tested online and refined based on the test feedback. The purpose of the survey was to identify and collect information

on biosecurity projects, trainings, and websites (see Marić et al., 2024). The data protection officer of the Estonian University of Life Sciences reviewed the survey before data collection and confirmed that it complied with the data protection requirements. Snowball sampling was employed to collect survey data (Lupo et al., 2016). The survey was distributed by the BETTER cost action mailing list, including close to 400 cost action members from different organizations and countries in Europe and elsewhere, and by the Federation of Veterinarians of Europe mailing list and LinkedIn. In addition, the members of the cost action were requested to share the survey with their colleagues and other persons who might consider the topics interesting. The data were collected from the 11th of July until the 2nd of September 2023. In total, 75 responses were completed.

ChatGPT (Chat Generative Pre-trained Transformer) version 3.5 was used to expand the search for websites on biosecurity. ChatGPT was developed by OpenAI and launched in November 2022. It is a large language model (LLM) used as a tool for tasks such as conversation, information retrieval, and text-based exploration (OpenAI, 2023). Its successful utilization hinges on crafting precise and contextually relevant prompts (Box 1). Prompt engineering involves formulating and refining these queries to optimize model performance and align with ethical and domain-specific considerations (Abhari et al., 2024). Separate searches were conducted at the end of the year 2023 using the keywords “farm biosecurity” and “biosecurity assessment tools”. ChatGPT was prompted in English to generate a list of 20 websites related to farm biosecurity in a general context and a list of 30 websites related to biosecurity assessment tools. Moreover, a request was made to identify 10 additional websites for each continent to obtain a comprehensive and continent-specific perspective on “Farm Biosecurity”. The latest training data used for this LLM was from September 2021, and it was used in this study.

After a sample of websites was identified, information on the features of each website was collected. The analysis of data was conducted by researchers. Identified websites were visited by two researchers, and data concerning the features of the websites were extracted manually into a spreadsheet file. The final, updated information was extracted from the websites in June 2024. The list of extracted information

Box 1

An example of ChatGPT prompt and a response for criteria to detect the best farm biosecurity websites.

Prompt (You - Researcher)	Using the data that you have available and to the best of your knowledge, I would like to create a spreadsheet with best 10 websites about farm biosecurity. Firstly, I would like to write me a paragraph with the criteria you use to pick those sites. Then in the vertical line of the spreadsheet I want to write the name of each site, in the next line place the link of the site, in the next line write in which animal species the site focus on and in the last line write a very small review of the website
Response (ChatGPT) - Introduction	To select the best 10 websites about farm biosecurity, I would consider the following criteria: 1. Relevance and Focus: Websites should primarily focus on farm biosecurity, providing information and resources related to disease prevention, control, and biosecurity measures specific to various animal species. 2. Authority and Credibility: Websites should be backed by reputable organizations, government agencies, universities, or experts in the field of animal health and biosecurity. 3. Quality of Information: Websites should offer comprehensive, up-to-date, and accurate information on biosecurity practices, guidelines, and research findings. 4. User-Friendly Design: User-friendly websites with easy navigation, clear organization of content, and search capabilities are preferred. 5. Multispecies Coverage: The selected websites should cover a range of animal species, including poultry, cattle, swine, and others, to cater to a broad audience. 6. Accessibility and Availability: Websites should be freely accessible to users without excessive subscription or membership requirements. 7. Visual Resources: Sites with diagrams, videos, and images that help convey biosecurity concepts effectively would be prioritized. 8. Regular Updates: Sites that are actively maintained and updated with the latest information and developments in the field of farm biosecurity are preferred.
Response (ChatGPT) - Criterion	Based on these criteria, here are the top 10 websites about farm biosecurity:
Follow up, text by ChatGPT	

(Appendix 2) was based on the results of the World Café held in Padua and on the results of [Saegerman et al. \(2024\)](#). For each website, the presence or absence of each desirable and technical feature was recorded, and the overall results were summarised. Extracted information is presented in Appendix 2 and summarised in [Table 1](#).

2.4. Comparative analysis

After data collection, the websites' features were organized in the order of perceived importance. This ranking was based on the voting results of four groups at the end of their World Café discussion and on how many times each topic was mentioned during the final discussion of each group. The ranking was used to indicate the importance of each topic, so that the feature with the most votes and mentions was considered the most important feature.

The features observed in the sample of websites were counted. On one hand, it was counted how many features each website had. On the other hand, it was counted how many websites had the specific feature present. The improvement potential of each website was assessed by counting the number of examined features that were not present on the website. The improvement potential regarding a specific feature, by contrast, was examined by counting the number of websites that did not have that feature. For this purpose, features examined in this study were ranked by counting the number of websites with and without features, so that the least commonly presented feature on the reviewed websites had the highest improvement potential (ranked first in terms of improvement potential). Finally, the rankings were compared, and a

Table 1

Summary of World Café results regarding whether the presence of a feature is needed (✓) in a biosecurity website, and whether detailed (●) or simplified and easy-to-understand information (×) was suggested to be needed by the target group (veterinarians or farmers).

Priority rank*	Feature	Target group	
		Veterinarians	Farmers
1	Practical applications Practical information about biosecurity implementation, for example checklists for implementing biosecurity in different production systems Protocols, guidelines and tools on how to assess biosecurity on farm Developing effective biosecurity plans (how to) Self-evaluation tool for veterinarian's knowledge level	✓ ✓ ✓ ✓	✓
2	Information on legislation Legislation, regulations, laws, rules and principles	✓●	✓×
3	Resource repository for biosecurity in various production systems Links to other websites related to biosecurity Biosecurity guidelines or manuals Biosecurity rules and principles Biosecurity Wiki and PDF materials Literature and publications, validation content such as research reports Youtube® channels and other media sources	✓ ✓● ✓● ✓● ✓● ✓●	✓ ✓× ✓× ✓× ✓× ✓×
4	Disease information Transmission methods, types of diseases, zoonoses, and epidemiological factsheets.	✓·	✓×
5	Effective veterinarian-farmer communication guide Communication support Guidelines for promoting behavioural change Psychology of behavior change	✓ ✓ ✓	
6	Training resources Online courses with certificates, short 3–5 min videos with questions, focused short modules, and links to continuing education opportunities. Other training courses without certificate available (training content or links to training content)	✓● ✓●	✓× ✓×
7	News Latest advances in technology, new tools, legislation, and disease news/notifications.	✓	✓
8	Expert directory Expert directory by country/production system	✓	✓
9	Questions & Answers (Q&A) Q&A forum for experience exchange or to take an expert opinion	✓	✓
10	Costs and benefits Insights from cost-benefit analysis	✓	✓
11	Sponsored content as part of website's financial viability Does the website have any visible sponsor or advertiser?	✓	✓
12	Postings Job, research and project announcements in the field of biosecurity	✓	✓

* The priority ranking indicates the order that was determined based on the World Café results by participants and facilitator concerning a website for veterinarians, but for farmers.

correlation between the rankings was calculated.

3. Results

3.1. Desirable features for a biosecurity website after the World Café

3.1.1. A biosecurity website for veterinarians

The participants of the World Café suggested that the main aims of a website targeted to veterinarians should be to raise awareness about biosecurity, to connect biosecurity with legislation, continuous education, updating knowledge, and helping veterinarians be good advisors. The most essential features of a biosecurity website for veterinarians or farmers are summarised in [Table 1](#). According to the World Café overall results, five most important features of a biosecurity website for veterinarians were the following: First, the website was proposed to provide practical materials such as biosecurity evaluation protocols, case studies, or best practices to illustrate and support the evaluation and implementation of biosecurity measures. The participants suggested that short, 3–5 min online videos could be valuable advisory and training tools. The website was proposed to contain protocols for assessing a person's level of biosecurity knowledge. Second, a website was proposed to provide information on legislation, regulations, laws, and biosecurity rules. Third, participants emphasized the importance of linking the website to training opportunities, scientific literature, validated resources, relevant organizations (both local and international), and online tools. Fourth, a dedicated disease information section was considered essential. This included providing disease news, notifications, status updates, and disease fact sheets explaining transmission pathways and risk factors. Fifth, a website was proposed to have a communication support section. This was to provide guidelines on how veterinarians can communicate with farmers about biosecurity, how to promote behavioural change among farmers, and how to understand the psychological aspects of veterinarian-farmer interaction. The desire for communication support material was specific to the website for veterinarians.

The participants agreed that the website should be mobile-friendly and have mainly free-of-charge materials, although the possibility of having premium content requiring a paid subscription to ensure the sustainability of the website was also discussed. Overall, the participants indicated that the contents of a biosecurity website should be easily accessible and clearly understandable. It was considered important that the contents are validated by scientifically proven information (i.e. facts) and are practical and up to date. Practicality can be enhanced by providing instructional videos or other resources from commercial farms that demonstrate the application of theories in practice, along with step-by-step guidance on developing a biosecurity plan.

The biosecurity website was proposed to act as a repository of biosecurity information. Because maintaining and updating information can be resource-intensive, the participants proposed that the website should provide links to information provided by national, European, and global organizations such as the European Commission, Federation of Veterinarians of Europe, World Organization for Animal Health, national contact points, and educational organizations. Furthermore, the website was proposed to have an inventory of biosecurity experts by country or production system, questions and answers section or a discussion forum to exchange experiences and ask questions, and information on costs and benefits of biosecurity. It was recommended that the contextual requirements for a good website should be applied with greater detail and specificity for veterinarians than for farmers, while ensuring that the content remains simple and easy to understand for both target groups.

3.1.2. A biosecurity website for farmers

The requirements for a biosecurity website for farmers were partly similar to those of veterinarians ([Table 1](#)). However, there was more emphasis on the accessibility and language clarity of the website for

farmers. The participants highlighted the importance of regularly updating the website and ensuring the accuracy of its content. They emphasized that validated information, along with links to relevant studies, is crucial to prevent the spread of misinformation among farmers. Additionally, they expressed a preference for the website to be managed by a recognized authority, such as an international organization, as it would have the necessary resources to validate, maintain, and update the content effectively. In addition, the economic sustainability of the website was discussed. The participants concluded that access to the website should be free for the farmer. Because maintaining a website is costly, it is proposed that securing revenue streams for the website could include farmer subscription for performing self-evaluation tests, farmers associations or companies supporting the website, and promoting company products (e.g., boots, disinfectants) in a “where to find” section. The participants considered it important that the website is designed for farmers and that the contents are translated into multiple local languages. This would help in disseminating information locally and making it cognitively accessible to farmers.

The website was recommended to be ‘smart and simple’ in design, focusing on conveying information in the easiest possible way and emphasizing practical information by using simple but valid language and focusing on practical information was emphasized. Proposed useful elements for this included lessons on biosecurity, supporting photos and short videos (1–2 min), examples of farms that implement biosecurity measures successfully, a visually intuitive branching menu based on photos to help navigation on the site, an interactive map of good farm design, podcasts with farmers (e.g. biosecurity problems and solutions), biosecurity instructions for specific problems, a frequently asked questions section, and a pre-trained chatbot or a discussion forum to ask questions and to receive answers. An inventory of downloadable materials, news about infectious disease outbreaks, national and European regulatory information, and self-evaluation tests with the possibility of receiving a certificate and feedback on observed knowledge and biosecurity gaps were also suggested.

3.2. Review of websites

Based on the survey, 61 websites were identified, and based on the ChatGPT search, 102 websites in 12 different languages were identified. Of the 163 websites identified through the survey or ChatGPT search, 105 were excluded in the first stage, because they were duplicates, did not contain relevant biosecurity information, were not accessible by the research team (for example because they required login that was unavailable), were in a language that the team could not process, were not in the scope of the current study, or were already identified by the online survey ([Fig. 2](#)). Information that was behind a paywall or that was not open access was not retrieved.

At the second stage, 58 websites were further reviewed. Ten of these websites were excluded in the second stage because they contained only minimal biosecurity information, for example, just one short text page, or were related to a biosecurity training but did not contain other biosecurity information. Therefore, the final dataset included 48 websites that mainly had content in English. ([Fig. 2](#)). Besides English, some of the websites examined in the second stage provided information in French (5 websites), German (7), Italian (2), Dutch (1) or Hindi (1). In the first stage there were also other languages, such as Norwegian, present in the sample.

Altogether 28 websites provided information on multiple species. In total, 17 websites focused on single species only, mostly pigs, cattle, or poultry. For some websites, the public information did not specify whether it was focusing on specific species. Most websites contained information on both internal and external biosecurity, although there was more emphasis on external biosecurity. Less than half of the websites were interactive.

[Fig. 3](#) presents the occurrence of different features on the reviewed websites in total, ranked by order of improvement potential (i.e.

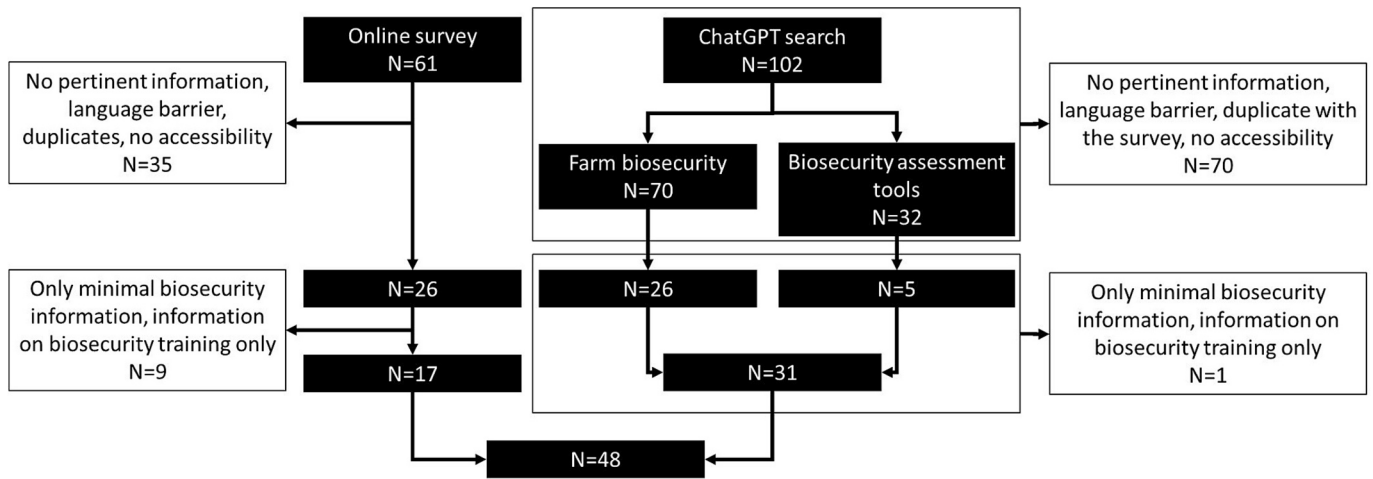


Fig. 2. Flow chart of the number of biosecurity websites included in and excluded from the study at its' different steps.

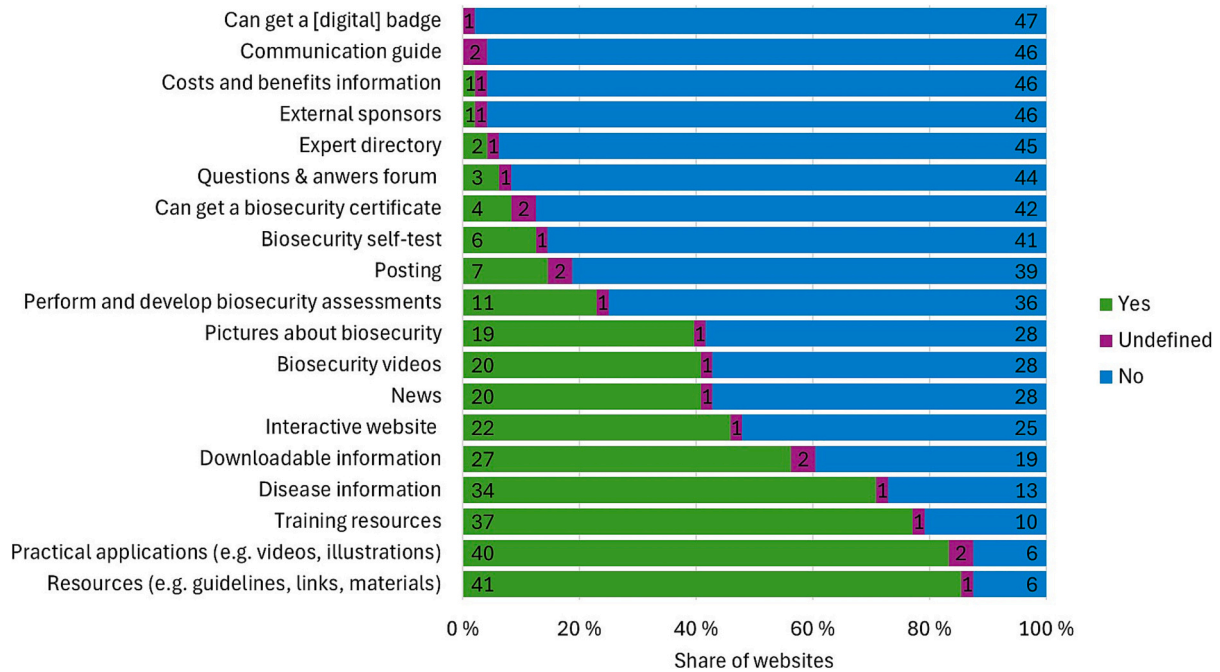


Fig. 3. The number of reviewed biosecurity websites where certain feature was or was not present. The numbers within the bars represent the number of websites. The rows are presented in the order of improvement potential (i.e. the number of features that were absent). "Undefined" refers to cases where it could not be concluded with certainty from public information whether the feature was present.

proportional to the number of features that were absent). Guidelines, links, and other resources, as well as practical applications were available on the majority of reviewed websites. Some training resources were also widely available. Website interactivity, disease information, downloadable content, and disease news were present in about half of the websites.

The least commonly observed features were materials on how to communicate about biosecurity, information about costs and benefits, and the option to obtain a (digital) badge from online educational activities. Communication advice, which was considered important for veterinarians, was almost non-existent on the reviewed websites. Other features that were rarely available on the reviewed websites included biosecurity self-evaluation tests, job postings, a questions and answers section, and an expert directory.

Fig. 4 presents the distribution of the number of features that were present per website. As indicated by Fig. 4, over half of the reviewed

websites had a maximum of ten studied features present. Even the most advanced websites did not possess all the features. However, the most comprehensive websites were mainly missing communication guidance materials and contents that were not on the top of the list presented in Table 1.

Fig. 5 illustrates the relationship between the improvement potential and the priority of topics as identified in the World Café. The most important features identified by the World Café tended to be most commonly present on the websites. When comparing the rankings of feature's improvement potential and how important it was considered based on the World Café, few features were given inadequate attention on the websites. Given the importance of the topic, websites were found to give relatively little attention to developing effective biosecurity plans, offering self-evaluation assessments of knowledge, and offering an effective veterinarian-farmer biosecurity communication guide. Job and other postings, by contrast, were quite common on the reviewed

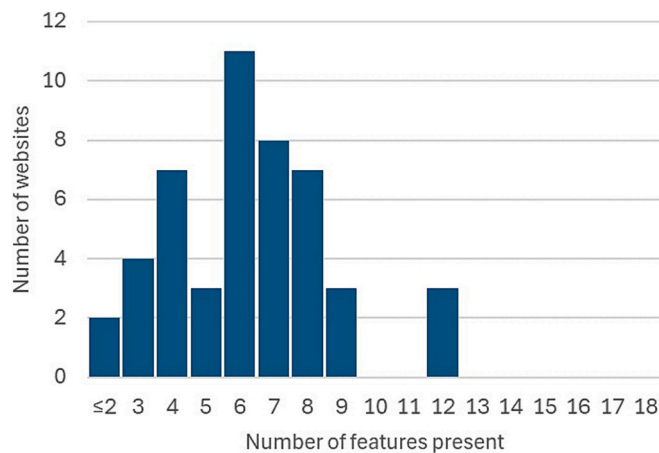


Fig. 4. A histogram presenting the number of biosecurity websites by the number of features present on the website. The maximum number of features considered was 20.

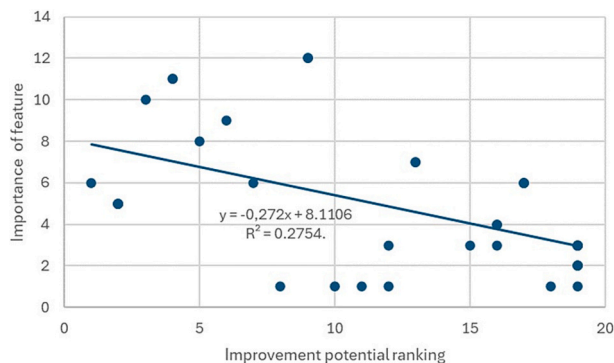


Fig. 5. The relationship between improvement potential ranking and importance of feature for 22 website features. The horizontal axis (Improvement potential ranking) reflects how many ‘no’ responses each feature received (see Fig. 4). A smaller rank indicates a greater need for improvement. (1 = the highest number of ‘no’s). The vertical axis (Importance Score) is based on the World Café results (Table 1). A higher score denotes greater perceived importance. Each dot represents a single feature, and the line indicates a linear relationship between the rankings.

websites even though the World Café participants considered to be among the least important features.

4. Discussion

4.1. General remarks

The aim of this study was to gain insights on what constitutes a good website and whether these desirable features are present on the websites rather than to examine the quantity and quality of the content in detail. Despite the importance of accessibility to biosecurity information, there is little research about the usability of biosecurity websites in herd health and animal disease management. This study addressed the key features of a ‘good’ webpage for veterinarians and farmers by using expert opinions and examined whether such features are present in a set of reviewed websites.

It was noted that in some of the reviewed websites, a very limited amount of biosecurity and disease-specific information was available. As a subjective observation made by the reviewers of websites, some websites were user-friendly, while others were complex and lacked a clear target audience. A few websites offered high-quality and in-depth information in a clearly structured manner, downloadable files,

illustrative examples, including short and concise biosecurity training videos, and guiding other web links for diseases or even regulatory information. Hence, the information available on the websites may vary substantially.

Experts participating in the World Café emphasized the importance of developing a multilingual, user-friendly online platform to enhance biosecurity awareness among veterinarians and farmers. By offering biosecurity lessons in multiple formats—such as photos, videos, and podcasts—the site can accommodate varied learning preferences and ensure practical, easily digestible information on biosecurity. Moreover, visual-based menus and interactive maps can help users navigate content quickly and apply relevant practices to their local context (e.g., identifying regional disease risks). These features reinforce high-quality learning experiences by presenting complex material in a straightforward manner. To further improve the site’s relevant suggested pre-trained, LLM-based chatbots that offer real-time responses to user questions about livestock diseases, outbreak protocols, or farm audits. This approach would provide on-demand support and foster interactive and adaptive learning, essential for busy professionals seeking quick advice.

Downloadable self-assessment tests with personalized biosecurity reports can give users actionable feedback on their current practices, guiding them toward targeted improvements. Self-tests to assess farmers’ knowledge on a certain topic have been developed and appropriate tests can provide robust information about person’s knowledge (e.g. Jena et al., 2019). Moreover, farmer’s knowledge contributes positively for instance to farm’s economic performance and efficiency (e.g. Manevska-Tasevska, 2013). In the reverse, lack of knowledge is one of the reasons for the main deficiencies in biosecurity measures like personnel entry and hygiene practices (Souillard et al., 2025). Including up-to-date news on disease outbreaks, as well as evolving regulations and best practices, ensures that the platform remains a trusted, continually refreshed resource for veterinarians and farmers. Ultimately, the combination of diverse teaching methods, interactive tools, and current information contributes to both the quality and usability of biosecurity webpages, potentially strengthening the overall impact on disease prevention and control.

The management of the website should be handled by an authorized organization and be free of charge for farmers. The latter was suggested because there were doubts about whether farmers would be willing to pay for the biosecurity content. However, even free of charge content does not mean that the farmers would be using the website. Therefore, it is particularly important that the contents are also robust, useful in practice, and motivating. For veterinarians, the website should provide detailed protocols, guidelines, and tools for assessing biosecurity, as well as materials for creating biosecurity plans, enhancing communication with farmers and promoting behavioural change among veterinarians’ customers. Easy access, clarity, and availability in the users’s native language are essential for both farmers and veterinary practitioners. Because most websites had only some of these features present, there is a considerable improvement potential, even if some websites had very good content. Because there is a lot of animal health information available on the Internet (Lyon et al., 2013), a biosecurity website should be easily accessible and findable.

4.2. Practical applications and disease information

Effective implementation of biosecurity measures at the farm level requires a comprehensive understanding of the specific species involved, the pathogens that cause risks, and particular livestock production systems in place (Graham et al., 2008; Larson, 2008). A good biosecurity website should go beyond guidelines, regulations and resource links, by providing practical tools, real-world case studies, and actionable materials. While many reviewed biosecurity websites included these elements, there is a need for more comprehensive, user-friendly, and accessible resources that support effective biosecurity implementation

at the farm level. A comprehensive resource repository would enhance disease prevention and control across different production systems, ensuring the protection of human, animal, and plant health, the environment and trade (Kambey et al., 2020; Lestari et al., 2021; Renault et al., 2021; Huber et al., 2022).

Websites can be improved by adding online tools for veterinarians, farmers and farm workers to assess their own level of biosecurity knowledge. Interactive features such as question and answer forums for exchanging experiences or expert consultation are rare but useful. Sections with news and updates on relevant regulations, or information about the costs and benefits of biosecurity, are also rarely available on biosecurity websites. Providing information about economic insights and the usefulness of biosecurity measures is important because such information can affect farmers' willingness to implement biosecurity measures (e.g. Lupo et al., 2016; Niemi et al., 2016). The language and representation of news and information should be comprehensive, validated, and understandable for farmers. The clarity of these sections is important, because regulations for example are context-specific and their interpretation is not always straightforward.

4.3. Biosecurity communication support

The least presented aspect, and therefore the largest improvement potential, was observed in relation to materials on how to communicate effectively about biosecurity. Although communication advice was found important for veterinarians, it was largely absent on the reviewed websites. Poor communication can lead to discrepancies between veterinarians and farmers, particularly in discussions on the importance of biosecurity practices, which can undermine trust and their working relationships (Ruston et al., 2016; Svensson et al., 2018). Veterinarians are the key source of information on animal health and management for farmers and play a key role in conveying information about practical biosecurity measures (Shortall et al., 2016; Damiaans et al., 2018; Moya et al., 2020). Therefore, veterinarians need effective communication skills, be proactive advisors, and provide consistent and general messages linked to ongoing monitoring and evaluation (Jansen and Lam, 2012; Oliveira et al., 2018).

Veterinarians have the knowledge and opportunity to assess and discuss biosecurity on farms, but there is evidence that they lack skills for communicating the knowledge (Denis-Robichaud et al., 2020). A better understanding of farmer perspectives may help to improve efficiency in veterinary herd health management, and a farmer-centred approach, involving active co-creation of plans between individuals, is critical for engagement and commitment when tackling complex problems (Bard et al., 2019). Adherence or nonadherence with veterinary advice is related to trust (in the veterinarian, in the advisory process, or in individual preventive measures) and the feasibility of advice. Hence, it is essential for veterinarians to pay attention to farmers' needs, priorities, goals, motives, and perceptions regarding biosecurity measures (Svensson et al., 2019). Additionally, the timing and method of communication are important (Hall and Wapenaar, 2012). By incorporating an effective communication guide for veterinarians to use with farmers into a biosecurity webpage, veterinarians could enhance their ability to engage with and support farmers in implementing essential biosecurity measures. This guide should offer means for promoting behavioural change and addressing the psychological factors that influence farmers' decision-making.

4.4. Other aspects

World Café participants emphasized the importance of continuity and accessibility of websites. Economic aspects play an important role in this respect. A website should be free of charge because costs have been found to be the key reason why farmers generally do not participate in different herd health events or programs (Derks et al., 2014; Svensson et al., 2018; Gerber et al., 2020; Hool et al., 2020). In terms of finances, a

website supported by the government or local organization might be the most viable, because the private sponsorships of biosecurity websites appear is uncommon. The review process suggests that multilingual websites are uncommon. Multi-language contents become important when the target audience has two or more native languages. This is the case in multilingual countries or regions, when the website is targeting different countries or language groups or when farms have employees from different countries.

4.5. Methodological aspects and limitations

This study revealed the difficulty of defining what constitutes a biosecurity website. One of the questions discussed in the World Café, as well as among the authors, was "when is information on a website sufficient for it to be counted as a biosecurity website?" A subset of websites with comprehensive information provided good examples for other websites. Besides the amount of information, it is essential for future studies to pay attention to the quality, validity, and understandability of information. A website with a limited amount of information that is presented in an easily understandable form may be more valuable and economically more viable to maintain than a website with poorly presented information.

ChatGPT proved valuable, easy, and fast to use in mapping existing biosecurity websites. The continent-focused research, particularly in Oceania, yielded interesting results. It emphasized the importance of cross-referencing information to confirm the data. LLMs often struggle in understanding the context of user queries, especially if they are vague or ambiguous. It can lead to unsatisfactory search results, if the models do not interpret the user's intent accurately (Shamsitdinova et al., 2024). Precise and well-structured prompts are essential to mitigate this issue (Samsami, 2024). However, in this study the LLM was only used to identify websites, not to analyse their content.

A limitation of this study was that most participants of the World Café had a background in veterinary medicine or were working in academia. Moreover, the participants did not have to worry about the budget limitations or the feasibility of implementation when defining a feature-rich, multi-lingual, LLM-enhanced, and constantly up-to-date website. Therefore, the results indicate experts' perceptions regarding the preferred features of a biosecurity website, and the views of veterinarians, farmers, or expert website developers may not be fully reflected in the data. However, most participants had been working with farmers and veterinarians, and therefore their views were not unknown to the participants.

We recommend deliberation on the main findings with the target groups such as farmers and veterinary practitioners to further refine the key information needed to design a good biosecurity website that fits the needs and expectations of key actors. We also recommend further surveys to capture possible variability caused by contexts, such as country, culture, profession, and education.

Survey data were collected by using snowball sampling. Therefore, the data may not be representative of all of Europe. While the response rate cannot be determined, the number of responses may have been reduced because the survey was conducted during the summer. Nevertheless, the survey provided useful information about biosecurity websites.

Reviewed websites were mainly in English. Websites in other languages were not fully covered by the study. Despite this limited focus, the sample provides useful information about biosecurity websites and their development needs. Moreover, this study focused on the availability of certain features of biosecurity websites, but the quality of information present on a website was not evaluated in-depth. Further studies could examine the quantity and quality of biosecurity information that is available on biosecurity websites.

5. Conclusions

In conclusion, an easily accessible “good” website would possess several features and validated content. These include practical applications, preferably supported by videos and illustrations, a resource repository for biosecurity in various production systems, an effective guide to communicate on biosecurity, training resources, disease information, news, an expert directory by country and production system, a questions and answers forum for experience exchange or expert consultation, and cost-benefit analysis insights. However, the current websites vary in terms of their comprehensiveness. The results suggest that the biggest improvement potential among the websites is in adding a guide that helps veterinarians communicate effectively with farmers about biosecurity, cost and benefit information, biosecurity self-evaluation tests, and videos and illustrations on biosecurity measures to the websites.

Declaration of generative AI in scientific writing

ChatGPT version 3.5 was used to search for biosecurity websites. AI was not used to analyse the data or to generate text of the manuscript.

CRedit authorship contribution statement

Ramazan Yildiz: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Georgios Batikas:** Writing – review & editing, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. **Anna Maria Iatrou:** Writing – review & editing, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. **Alberto Allepuz:** Writing –

review & editing, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Blerta Mehmedi:** Writing – review & editing, Investigation, Conceptualization. **Rreze M. Gecaj:** Writing – review & editing, Investigation, Conceptualization. **Marco De Nardi:** Writing – review & editing, Investigation, Data curation. **Ina Toppari:** Writing – review & editing, Investigation, Data curation. **Constance Wielick:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Claude Saegerman:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Maria-Eleni Filippitzi:** Writing – review & editing, Investigation, Conceptualization. **Tarmo Niine:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jarkko K. Niemi:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Distribution of participants of the World Café by country

Country	Number of participants
Albania	1
Belgium	5
Croatia	1
Estonia	2
Finland	2
France	2
Germany	2
Greece	3
Ireland	2
Italy	13
Kosovo	1
Montenegro	1
Netherlands	2
North Macedonia	2
Norway	1
Poland	1
Portugal	1
Romania	1
Serbia	7
Slovenia	2
Spain	5
Sweden	1
Türkiye	4
Ukraine	1
United Kingdom	4
Grand Total	67

Appendix B. Features examined when reviewing the websites

Link to the webpage

In what language is the webpage?

If training is included, for whom it is targeted?

Is the webpage free to use (yes/no)?

What is the cost for accessing information on the webpage (amount of fee for example)?
 For which animal species biosecurity information is provided?
 For how many different diseases biosecurity is provided?
 Does the webpage have the following features?
 Practical applications (videos, Illustrations, short information offerings).
 Is the website interactive (yes - you can do tests etc. no - only text and maybe a few pictures).
 Does the webpage have some kind of self-evaluation test about biosecurity? (yes/no).
 Resources (Guidelines, information on legislation and regulations, biosecurity rules, other materials, links to other sources of information).
 Can you download biosecurity related information from the website? (yes/no) (a pdf leaflet/presentation/poster etc).
 Communication Guide.
 Perform and develop biosecurity assessments.
 Training resources.
 Can you get a certificate on biosecurity from this webpage? (yes/no).
 Can you get a [digital] badge on biosecurity from this webpage? (yes/no).
 Disease information.
 News
 Experts Directory.
 Questions & answers forum.
 Cost-benefit information, marketing
 Sponsors (other than organization that maintains the website)
 Sponsors
 Posting (jobs etc.)
 Does the website have videos about biosecurity? (yes/no)
 Does the website have pictures about biosecurity? (yes/no)
 Who are the contributors? Who made the webpage? Provide organization's name if you cannot find person or if it is anonymous.
 Who updates the webpage?
 When was the webpage last updated?
 Does the webpage have reference list of publications? (yes/no).
 Brief description of what type of biosecurity information is provided (internal/external biosecurity etc.)?
 Can you use website offline? (yes/no)

Appendix C. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.rvsc.2025.105938>.

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