Regulatory Mechanisms in Biosystems

ISSN 2519-8521 (Print)
ISSN 2520-2588 (Online)
Regul. Mech. Biosyst.

Forensic expertise of suspected flaws in organizing and carrying out veterinary-sanitary measures that have allegedly led to the emergence and spread of infectious diseases of animals

I. V. Yatsenko*, S. A. Tkachuk**, L. B. Savchuk***, A. B. Mushynskyi***, T. S. Tokarchuk***

*National Scientific Center Institute of Forensic Expertise named after Honored Professor M. S. Bokarius, Kharkiv, Ukraine
**National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine
***Podillia State University Higher Educational Institution, Kamianets-Podilskyi, Ukraine

Article info

Received 10.12.2024
Received in revised form 15.01.2025
Accepted 18.02.2025

National Science Center "Institute of Ship Expertise named after Honored prof. M. S. Bokarius" of the Ministry of Justice of Ukraine, Zolochivska st., 8, Kharkiv, 61177, Ukraine. Tel.: +38-067-186-06-05. E-mail: yacenko-1971@ukr.net

National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine.

Podillia State University Higher Educational Institution, Kamianets-Podilskyi, Ukraine.

Yatsenko, I. V., Tkachuk, S. A., Savchuk, L. B., Mushynskyi, A. B., & Tokarchuk, T. S. (2025). Forensic expertise of suspected flaws in organizing and carrying out veterinary-sanitary measures that have allegedly led to the emergence and spread of infectious diseases of animals. Regulatory Mechanisms in Biosystems, 16(1), e25041. doi:10.15421/0225041

The article considers the matters associated with reasons for conducting and criteria and peculiarities of forensic expertise in cases of suspected flaws in organization and execution of veterinary-sanitary measures as a part of criminal investigations related to disease outbreaks. It provides a rationale for the questions that could be put forward by a subject of assignment of forensic veterinary expertise for a forensic expert to solve during investigation of a suspected violation of Article 251 of the Criminal Code of Ukraine (violating veterinary rules), in particular, in cases of suspected shortcomings in organizing and conducting veterinary-sanitary events for control of infectious diseases of animals. During a forensic-veterinary investigation, a forensic expert has to determine whether the extent and content of the measures taken to prevent the emergence and spread of diseases, and also to combat those diseases, had been adequate, as well as whether they adhered to the current institutional instructions. To generalize and assess the conducted veterinary-sanitary measures against the background of emergence and spread of epizootics (panzootics), the authors propose the following algorithm: 1) determining the presence or absence of certain documents (veterinary and such issued by the State Emergency Anti-Epizootic Commission) in the materials of criminal investigation that confirm or refute the fact of conducting veterinary-sanitary measures against infectious diseases in animals; 2) assessment of interdependence of the records; 3) assessing whether the conducted veterinary-sanitary measures for eliminating the infectious disease conformed to the requirements of the normative-legal acts of Ukraine or other normative documents 4) assessment of the extent and quality of the conducted measures; 5) substantiation of the types of flaws during the veterinary-sanitary events; 6) assessment of cause-effect; 7) substantiating the objective and subjective causes of the flaws in the measures. Practical importance of using the algorithm proposed by the authors of this article regarding veterinary-forensic identification of flaws in veterinary-sanitary measures against infectious diseases guarantees the reliable solution to the problems that law enforcement and courts face while investigating criminal violation of veterinary rules. It provides the domestic scientific and practical forensic activities with new opportunities, enhances the efficacy of assigning and of the productivity of forensic-veterinary expertise, provision of a substantiated and objective conclusion of an expert in a categorical form, and also creates reliable conditions for the courts to deliver well-grounded procedural rulings.

Keywords: forensic-veterinary expertise; conclusion of expert; epizootic; panzootic; infectious diseases; transboundary infections; anti-epizootic measures; flaws; criminal justice.

Introduction

There are no doubts regarding the relevance of forensic-veterinary assessment of alleged malpractice by workers in veterinary medicine that might have led to negative outcomes, particularly, violations during anti-epizootic and other veterinary-sanitary events that entailed emergence and spread of acute and highly contagious infections in animals, and oftentimes anthropozoonoses. Nonetheless, this topic remains poorly studied across scientific sources and is not sufficiently discussed (Yatsenko, 2023; Lubroth, 2024).

Forensic veterinary expertise (hereinafter, FVE) plays a decisive role in obtaining the actual data and determining the circumstances in which malpractice in organization and execution of preventive veterinary-sanitary measures had taken place (hereinafter, VSMs). It is a means of presenting evidence, and the experts' conclusions are some of the most scientifically substantiated evidence in criminal cases (Hernandez-Jover et al., 2024). However, the opportunities of FVE in cases of suspected malpractice (flaws) in carrying out duties by veterinary medicine workers directly depend on the methods developed to determine these flaws.

The significance of this problem is highlighted by the fact that when assigning FVE to case investigations foreseen in Article 251 (violation of veterinary rules) of the Criminal Code of Ukraine (hereinafter, CCU) or Article 107 (violation of rules of quarantine of animals and other veterinary-sanitary requirements) of the Code of Ukraine on Administrative Violations (hereinafter, CUoAV), law-enforcement agencies and courts face difficulties in obtaining a clear understanding of the subject and object of research. Therefore, expert questions are to be solved through expertise. However, forensic-veterinary experts encounter challenges such as the absence of algorithms for conducting such studies and criteria for expert assessment of obtained results (Yatsenko, 2023).

Acute and highly contagious diseases are transboundary (emerging) diseases (hereinafter TBDs), such as African swine fever virus (Brown, 2021), hoof/foot-and-mouth disease (Gortázar, 2022), Schmallenberg virus (Endalew, 2019), anthrax (Kozytska, 2023), nodular dermatitis of cattle (Eom, 2023; Moudgil, 2024), ovine rinderpest (Gongal, 2022); swine influenza (Li, 2021), highly pathogenic avian influenza (Charostad, 2023; Ly, 2024; Hunter, 2022), malignant catarrhal fever (Wainwright, 2024), etc. Those diseases can quickly and uncontrollably spread across borders among animal populations, causing their mass death, and inflicting great harm on the economy and society, as well as the environment (via corpse management), since there are usually no effective means of treating and preventing them, and thus can be used as a tool of agro/bioterrorism and pose a great threat to state security (Torres-Velez et al., 2019; Calkins et al., 2020; Zucca, 2020).

Measures to prevent emergencies, particularly, TBDs, can affect the economy, lead to trade restrictions, jeopardize food safety, lead to loss of animal productivity or death of people, and can easily spread to other countries and reach the scales of epidemics, which means financial losses and increased costs for the control of biosecurity or prophylaxis events (Bohach et al., 2020). Co-working with different countries of the world is an effective tool of controlling those illnesses at the starting stage. The global structure of progressive control of TBDs comprises the FAO (Food and Agriculture Organization) and the World Organisation for Animal Health (WOAH), which are platforms inviting regional and subregional organizations and national veterinary bodies to work toward progress in combating emerging animal diseases (Bashchenko et al., 2017; Andreychyn, 2019; Clemmons et al., 2021).

The World Animal Health Information System (WAHIS) receives and publishes the data collected by veterinary services of different countries, in particular, detailed information on outbreaks of diseases recorded in the WOAH list (Tambo et al., 2022; Caceres et al., 2023; Qiu et al., 2023). Those data illustrate the risk that diseases pose to animals, allow the countries at risk to implement the measures required to prevent the spread of TBDs or minimize their impact, mitigate disease-associated risks to vulnerable animals, as well as people (Caceres et al., 2020; Lewis et al., 2021; Stevenson, 2021). The platform presents an accurate collection of evidences at locations of the events, which can be used by forensic-veterinary experts during assessment and interpretation of results (Marchetti et al., 2023).

The forensic-veterinary expertise in cases related to emergence and spread of acute and highly contagious infectious diseases of animals due to malpractice of workers in veterinary medicine is different from other types of forensic expertise due to the specifics of the subject, object, expert tasks, and special requirements to the competence of members of the expert commission.

Therefore, it has to be noted that currently in Ukraine and other countries, no methods of forensic expertise have been developed for suspected malpractice in organizing and performing VSMs that might have led to emergence and spread of infectious diseases of animals. Thus, the subject and objects of research have not been outlined and expert questions that FVE must solve have not been formulated, and there are also no algorithms of conducting such studies and no criteria for expertise of results.

Thus, within forensic investigation of an alleged crime foreseen in Article 251 of the CCU regarding violation of veterinary rules, forensic-veterinary identification of flaws in organization and execution of VSMs that resulted in outbreaks of acute and highly pathogenic diseases and mass death of animals (mammals, fish, bees, and others) there is a solid guarantee of obtaining an objective and substantiated conclusion of an expert, which would be one of evidences in a court of law, in particular, for compensating animal farms for harm.

The objectives of the research were designing and substantiating a theoretical-gnosiological construction of forensic expertise in cases of suspected flaws in organization and carrying out VSMs that might have led to emergence and spread of infectious diseases of animals, and also revealing the ways of using them in forensic expertise taking into account specifics of its subject and objects.

The original contribution of the research is that for the first time in the global practice, the authors have proposed the methods of forensic expertise of suspected malpractice in organizing and carrying out VSMs for cases related to emergence and spread of infectious diseases of animals, which can improve the legislation of Ukraine on violations of veterinary rules of quarantine of animals and other veterinary-sanitary requirements, and also would obviously have a positive effect on the forensic-veterinary sphere.

Materials and methods

To achieve the goals of the research, we used general and specific scientific methods, including:

– Analysis, synthesis, analogy – to identify the core principles of the categorical apparatus of suspected flaws in VSMs that might have led to emergence and spread of infectious diseases in animals;

– The formal-logical method allowed us to structure the logic of subject, objects, expert tasks, stages in the general algorithm for forensic-veterinary determination of flaws in organizing and carrying out VSMs against the emergence and spread of infectious diseases;

– The comparative method allowed us to determine the level of research on the problem of identifying malpractice in VSMs against the emergence and spread of infectious diseases in animals in Ukraine and abroad;

– The logical-grammatical method was employed to determine the etymological content of flaws in VSMs against infectious diseases of animals, identifying the shortcomings in the legislation of Ukraine in order to develop proposals regarding its improvement;

– The logical-semantic method from the perspective of modern veterinary medicine and forensic-veterinary expert practice allowed us to determine the core principles and formulate our definitions of the terms: "flaw in veterinary-sanitary measures against the emergence and spread of infectious diseases in animals", "introductory-preparatory, organizational-informational, research-analytical, generalizing-evaluating, and final stages". The objectives were to achieve a shared understanding of what they encompass in the context of FVE, identifying shortcomings in the legislation of Ukraine, and formulating proposals for its refinement;

– The method of legal analysis was used to analyze individual provisions of substantive and procedural legislation, and also well-known normative-legal acts of Ukraine dealing with the matters of expert delivery of justice in relation to duties, rights, prohibitions, and responsibilities of forensic veterinary expert in the novel legal field of Ukraine;

– The formal-legal method was utilized to consider the legal construction of the list of questions provided in the court order of the investigating judge (court) or request of the investigator regarding assignment of FVE of flaws in VSMs against the emergence and spread of infectious diseases of animals. Also this method helped reveal the content of the special veterinary and legal terms used;

– The comparative-legal method was used to analyze and compare the legal norms that regulate the work of veterinary-medicine professionals, the State Emergency Anti-Epizootic Commission (hereinafter, SEAEC) and forensic experts;

– The structural-systemic method was used to formulate and compile the tasks of forensic-veterinary expert to assess the quality of conducted VSMs and their flaws in case of their poor-quality organization and execution, which led to an outbreak of infectious disease in animals;

– The method of modeling aided us in predicting and developing the problems of the general algorithm for forensic-veterinary assessment of conducted VSMs and identifying their flaws that had caused emergence and spread of infectious diseases of animals;

The empirical foundation of the research was the analysis of conclusions from experts according to the results of FVE conducted during 2010–2024 at the Bureau of Forensic Studies of the Kharkiv State Zooveterinary Academy and at the National Scientific Center Institute of Forensic Expertise named after Honored Professor M. S. Bokarius of the Ministry of Justice of Ukraine.

By applying those and other methods of scientific research, we produced a comprehensive analysis, substantiation of conclusions, and practical recommendations.

Results

Understanding the nature, content, and construction of such a phenomenon as flaw in organization and execution of VSMs is crucial for a correct and objective determination of actual data during FVE. Thus, law-enforcement agencies and courts can accurately assess the actions of workers in veterinary medicine in cases of violations of veterinary rules, especially after an onset and outbreak of highly lethal infectious disease in animals. Therefore, we formulated our definition of the term "flaw in veterinary-sanitary measures in case of emergence and spread of infectious diseases in animals", which encompasses workers of veterinary medicine and SEAEC conducting poor-quality organization and execution of protective-quarantine, epizootic, diag-

nostic measures, and providing poor material-technological support, malpractice or lack of engagement by the abovementioned workers in their professional duties, which had caused an outbreak of infectious disease and mass death of animals, spread of pathogens of infections or other negative consequences.

Considering the mentioned definition, we should emphasize that VSMs should be considered inadequate (poor-quality) if their organization and execution have been mismanaged: the measures were conducted in an untimely manner, technically and technologically incorrectly, with no rationale, in insufficient amount; ineffectively, with violations of the current normative requirements (rules, instructions, recommendations, etc.).

We agree with Andreychyn (2022) who correctly pointed out that the drivers of emergence and spread of infectious diseases can be united in the following groups:

1) Zoogeographic – contact of people with animals that creates favorable conditions for transmission of pathogens, increase in their virulence, and emergence of genetic recombinations. Numerous infectious diseases of animals became zooanthroponoses.

2) Biological – genetic variances of pathogens (mutations, disassociations, modifications, recombinations, plasmids, bacteria, non-vertically transmitted modifications of viruses), due to which they attain new features of pathogenicity, virulence, and resistance to antimicrobial drugs, and form new natural hotbed zones.

3) Socioeconomic – increased population density and reduced quality of its living conditions, as well as war and natural cataclysms contribute to emergence of new infections and spread of the existing ones.

4) Engineered – intentional enhancement of pathogenicity of the causative agents, their resistance to antimicrobial drugs, as well as creation of new pathogens and development of their most effective combinations, and ways of dispersing them among people and animals for achieving maximum harm, which is bioterrorism.

The subject of expertise with the objective of determining the potential flaws in organization and execution of VSMs that might have caused the emergence and spread of infectious diseases is the total sum of actual data and the circumstances of criminal proceeding, in particular: poor-quality execution or non-execution of professional duties by workers in veterinary medicine, administration of the animal-industry facilities, or owners of individual farms, the SEAES, which had caused negative effects on animals, their death, loss of productivity. Those matters are evaluated by forensic experts according to the signs and properties of the examined objects as data carriers (animals, veterinary documents), using sophisticated veterinary knowledge. In order to solve the identificational, diagnostic, and situational tasks of FVE, the experts utilize the necessary means (methods).

The objects of forensic-veterinary study of potential flaws in organizing and conducting VSMs in cases related to emergence and spread of infectious diseases in animals are material sources of data on and documented evidences of the violations, recorded in the materials of criminal proceeding. The forensic expert commission must comprehensively, completely, objectively, and directly study those data during FVE based on special veterinary knowledge within the subjects of their expertise. A complex of methods and means are employed to solve the identificational, diagnostic, and situational tasks of forensic expertise set by a procedural document regarding the assignment of FVE by the commission.

The material objects comprise animals (domestic and wild, live and dead, animal-industry facilities, individual farms), while the records are veterinary documents: protocols of inspection at the event scene; schemes, photo- and video documentation, conclusions of the preliminary forensic expertise; protocols of investigative experiments; work instructions and job descriptions for workers in veterinary medicine; articles of association of the animal farm where the outbreak of infectious disease occurred, in particular:

– Acts (regarding disinfection of motor vehicles; household examination for epizootic diseases; removal and elimination (burning) of animal corpses; dismantlement and elimination (burning) of wooden constructions, wooden floors, and fresh manure; sampling biological material from animals, etc).

– Routes of epizootiological inspection teams at the hunting grounds;

– Data regarding the measures taken to prevent the spread of infectious-disease pathogens from an epizootic site;

– Description of animals at private farms;

– Protocols of the session of the State Emergency Anti-Epizootic Commission of the oblast and district state administration;

– Plan of organizational, veterinary-sanitary, and managerial measures aimed at elimination of an outbreak of infectious disease and prevention of spread of infection to the district;

– Protocols (of working meetings with heads of agricultural enterprises and heads of villages or urban-type-settlements where quarantine is enforced to prevent infection from spreading);

– Protocols of pathoanatomical necropsy of the animal corpses;

– Reports on the results of studies of pathological (biological) material;

– Order enforcing quarantine against an infectious disease in a settlement;

– Notifications of discovery of infectious disease;

– Orders enforcing checks of farms, landfills, and double rounds of inspection at the facilities;

– Information regarding conducting VSMs in a settlement;

– Schematic maps and other documents.

It should be noted that all documents provided for research must be original or duly certified copies, numerated and stitched.

The subjects of performing FVE in order to determine the potential flaws in organization and execution of VSMs in cases related to the emergence and spread of infectious diseases are veterinarians who have a qualification of forensic expert according to expert speciality 18.1 "Veterinary Researchers".

The main objective of FVE is solving diagnostic and situational tasks during research of objects in order to determine the potential flaws in organization and execution of VSMs in cases related to emergence and spread of infectious diseases. We should note that the diagnostic objectives of FVE include identifying the pathogen of contagious disease, the parameters of animals such as condition (ill, dead); forms of disease course (fulminant, acute, chronic); typical clinical signs of the disease (typical, atypical); and the clinical degree of severity in the sick animals (extreme, severe, mild, satisfactory).

The situational objectives of forensic expertise include determining the components of the event's mechanism, analyzing how objects interact in general within a specific context based on the traces they contain, and reconstructing the objective aspects of the crime dynamics from the condition of those objects, thereby recreating the material setting of the investigated event.

At this point, it is important to note that during pre-trial proceedings, it is necessary to gather all veterinary documents and organizational orders and instruction from the SEAEC or bodies of power that confirm the conducted VSMs. For an investigator, it is hard to do so through individual effort, since he or she does not possess special knowledge in the sphere of veterinary medicine, especially regarding epizootics and infectious diseases of animals. For this purpose, it is practical to involve a veterinary expert who would be a participant in criminal proceeding.

To solve the mentioned problems, we should emphasize that the vectors of using special veterinary knowledge while investigating a crime of violating veterinary rules (Article 251 of the CCU), particularly, regarding flaws in organization and execution of VSMs against the emergence and spread of infectious diseases in animals, can be as follows:

1) direct performance of FVE. As of now, the only forensic-expertise institution conducting FVE in Ukraine is the National Scientific Center Institute of Forensic Expertise named after Honored Professor M. S. Bokarius of Ministry of Justice of Ukraine. Unfortunately, no other forensic scientific institution of Ukraine has the conditions for conducting laboratory studies of biological and pathological material obtained from animals that have died, including those that had to be slaughtered. Therefore, during FVE, a forensic expert should submit a request to the subject of forensic expertise assign-

ment, asking for involvement of experts from certified laboratories in this procedure;

2) participation of the involved veterinary experts in:

– examination of the incident location (describing the clinical conditions of live animals, performing non-invasive examination of animal corpses);

– collecting and packaging samples of pathological materials from the animals that have died, including those compulsorily slaughtered, and also of those that are ill;

– Conducting laboratory studies of samples of biological and pathological material in authorized certified state laboratories;

– Conducting molecular studies of genome of the pathogens of infectious diseases at the National Scientific-Research Institute of Laboratory Diagnostic and Veterinary-Sanitary Expertise (Kyiv, Donetska Street, 30);

– Extraction of veterinary documents;

– Consulting an investigator or a person conducting an inquest when documenting an examination of a forensic site.

After gathering data within the investigation subject, the investigator compiles a report regarding assignment of FVE commission, and also writes a list to a director of forensic-expertise institution that will conduct the expertise.

During a forensic-veterinary study of records (veterinary documents) in order to determine the potential flaws in organizing and carrying out VSMs against the emergence and spread of infectious diseases in animals, we recommend designating five stages proposed, in particular:

1) Introductory-preparatory;

2) Organizational-informative;

3) Research-analytical;

4) Generalizing-evaluating;

5) Final.

The sequence is due to the fact that at different stages of forensic-veterinary study, an expert pursues different investigative objectives, because of the specifics of the subject and objects of research, practice of solving similar expert tasks, using different methods and means that are specific for each stage, and also peculiarities of effectiveness, verification, and acceptability of the obtained results from the perspective of the law.

Below, we characterize the functions and outlined the significance of each stage in the general algorithm for forensic-veterinary assessment of potential flaws in organizing and carrying out VSMs in cases related to emergence and spread of infectious animal diseases.

Introductory-preparatory stage

After a forensic-expertise institution receives a procedural document regarding assignment of FVE (request from an investigator or prosecutor, or court order) or a request regarding involvement of forensic-veterinary experts, the head of the expert institution or his or her deputy in expertise considers the received materials and appoints a responsible structural unit of the institution to conduct forensic expertise.

The head of the structural unit (laboratory) appoints a commission composed of forensic-veterinary experts, selecting a chairman who carries out only organizational tasks (Provision 4.5 of Section 4 of the Instruction on Assigning and Carrying out Forensic Expertise). The head receives the materials of criminal proceeding.

In general, the objectives of the commission of forensic-veterinary experts are as follows:

– Familiarizing with the procedural document on assignment of FVE and materials of criminal proceeding that are related to the subject of expert research; studying the list of questions put forward in the procedural documents about assigning expertise;

– Determining the condition of objects to be studied;

– Composing and filing requests to provide the experts with additional materials (if necessary);

– Outlining the subject of forensic expertise, and checking the connection between the subject and object of expert research, considering the questions put forward in the procedural document on FVE assignment;

– Conducting collaborative intermediate and finalizing meetings;

– Developing a shared program of studies, in particular, establishing the sequence in which the objects will be analyzed to yield fullest possible data and comply with the time periods of executing separate types of research;

– Assessing results of all research, generalizing them, and formulating a general unanimous conclusion (conclusions).

In order to determine the potential flaws in organization and execution of VSMs that might have led to emergence and spread of infectious diseases, forensic-veterinary expertise can be conducted only if the subject of the FVE assignment provides all necessary materials of the case. In certain reasonable circumstances, the head of the expert commission requests the subject of a FVE assignment to change its status into a complex forensic investigation: veterinary-commodity-value expertise (for example, to determine commodity values of animals that have died from African swine fever virus) and veterinary-economic (to determine the losses caused by the epizootic epidemic, etc.).

Organizational-informative stage

The time period of conducting forensic expertise is limited by the legislation. It "starts from a working day, the day after the expert institution receives the materials, and ends on the day when the expert provides a conclusion (or a report about the impossibility of drawing a conclusion" (sentence 1, Paragraph 6, Provision 1.13 of Section 1 of the professional Instruction) and "must not exceed 90 calendar days (Paragraph 1 of Provision 1.13 of Section 1 of the professional Instruction).

The head of the expert commission appoints a reporter in the investigation among members of the commission, or can be the reporter him or herself. Utilizing available information resources, the reporter searches for the current normative-legal acts, and also methods (for example, Methods of Forensic-Veterinary Expertise of Animal Corpses, 2022), instructions, for example, "Instructions for the Prevention and Control of African Swine Fever: Order of the Ministry of Agrarian Policy and Food of Ukraine, March 7, 2017, No. 111), rules, methodological recommendations, guidelines, protocols, scientific articles, monographs, and other modern publications used during forensic expertise. Then, the reporter analyzes those materials with members of the forensic-expert commission.

At the organizational-informative stage of FVE of the potential flaws in VSMs that might have caused emergence and spread of infectious diseases, the expert commission develops an algorithm of tasks of the forensic expertise for obtaining objective, well-grounded, correct, and truthful results, adhering to the procedural time periods for carrying this out (Fig. 1).

Familiarizing oneself with the materials of criminal proceeding includes studying the circumstances of the case, determining the list and content of individual veterinary and organizational documents and orders from the SEAEC, and the procedural document regarding assignment of the FVE commission. We believe it is important to note that during a FVE commission into the potential flaws in VSMs that might have led to emergence and spread of infectious diseases in animals, the subject of forensic expertise assignment can put forward the issues for forensic experts to solve, which are formulated for the first time by the authors, in particular:

1) What was the cause of death of the animals at animal-industry facility (individual farm) and was it related to infectious-disease pathogens discovered in their corpses?

2) When did the animal at the industrial facility (individual farm) die?

3) What harm can this infectious disease cause?

4) What measures had been taken to diagnose the infectious disease? Had the diseased animals at an industrial facility or individual farm been diagnosed correctly? If not, what were the flaws in the diagnosis?

5) Was the outbreak of infectious disease at the animal-industry facility (individual farm) been reported on time? If no, that what were the failures?

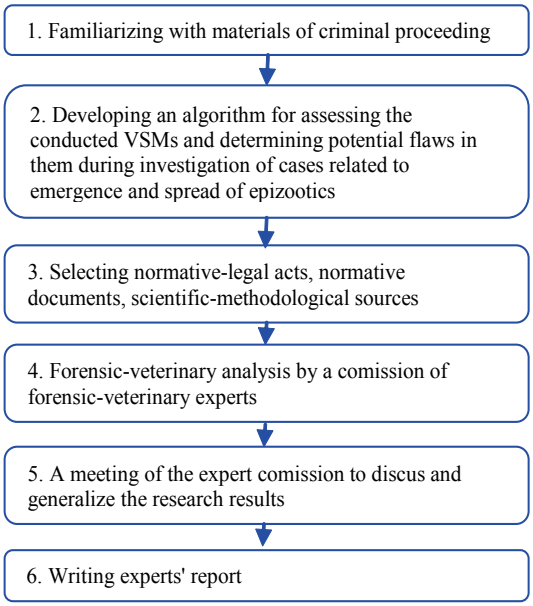

Fig. 1. Algorithm for conducting FVE to assess potential flaws in VSMs for investigation of cases related to emergence and spread of infectious diseases of animals

6) What veterinary-sanitary measures had been taken at the animal-industry facility (individual farm) to preclude the introduction and spread of the infectious-disease pathogen by carriers? Have those measures adhered to the current normative-legal acts of Ukraine? If no, what were the failures?

7) What veterinary-sanitary measures had been implemented at the animal-industry facility (individual farm) to prevent the spread of infectious disease? Have those measures adhered to the current normative-legal acts of Ukraine? If not, what were the failures?

8) What veterinary-sanitary measures had been implemented at the animal-industry facility (individual farm) to eliminate the infectious disease, and also prevent the spread of disease? Have those measures adhered to the current normative-legal acts of Ukraine? If not, what were the failures?

9) What veterinary-sanitary measures had been conducted after discovering animals that had died from infectious disease at the animal-industry facility (individual farm) and did those measures comply with the requirements of the normative-legal acts of Ukraine? If not, what were the failures?

10) Had the veterinary-sanitary measures to eliminate the consequences and prevent the spread of infectious disease at the animal-industry facility (individual farm) been carried out to a sufficient degree? If not, what were the failures?

11) Had the quarantine and restrictions at the facility where the outbreak had occurred been lifted in a timely manner and in accordance with the current normative-legal acts?

The proposed list could be expanded. Other questions could be put forward for the experts within the subject of the expertise and peculiarities of evidence presentation in the criminal proceeding.

This is the stage to decide upon the involvement of veterinary-medicine experts to conduct laboratory studies of pathological material from the dead animals, including slaughtered ones.

If the FVE commission involves experts who do not work at the state specialized expert institutions, although they professionally carry out expertise, the investigation is conducted according to the requirements of the Instructions On the Features of Forensic Expert Activities by Certified Forensic Experts Who Do Not Work in State Specialized Expert Institutions, approved by the Order of the Ministry of Justice of Ukraine dated 12.12.2011 No. 3505/5.

Research-analytical stage

This stage deals directly with studying and analyzing the veterinary and other documents present in the materials of the criminal proceeding, which belong to the subject of forensic-veterinary research. The purpose is to determine the flaws in VSMs that had caused the emergence and spread of an infectious disease. It is conditionally divided into two stages: Stage 1 is the analysis of records of the study and Stage 2 is determining the flaws in organizing and carrying out VSMs against the emergence and spread of infectious diseases (Fig. 2).

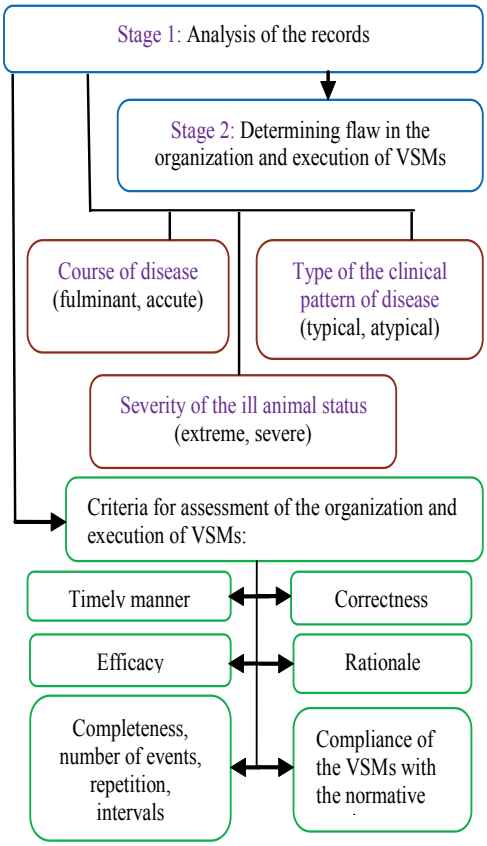

Fig. 2. Algorithm for conducting the research-analytical stage of determining potential flaws in VSMs in cases related to emergence and spread of infectious disease of animals

Analyzing the records in a forensic-veterinary study involves understanding, organizing, and examining each record in depth as systemic formations. This provides the search of optimal ways to solve the expert tasks, in particular for forensic-veterinary studies of potential flaws in VSMs that might have led to emergence and spread of infectious diseases in animals. For this purpose, analytical method of research should be used.

We state that the typical procedures of analysis of materialized objects to determine the flaws in VSMs are as follows:

– Outlining the subject and objects of study;

– Analysis and systematization of materialized objects present in the materials of criminal proceeding (for example: paper documents, electronic documents: footage, photo, etc.);

– Comprehensive and formal description of the structure of materialized objects (written on an institution's form, including the name of organization that issued it, name of the document, registration index, date, address, text, signature, and stamp);

– Identifying the objective of documenting and mechanism of functioning of a materialized object in the system of provision of VSMs in cases of infections in animals;

– Identifying the relations and interrelations among various records of the forensic-veterinary research.

During analysis of materialized objects of research, at first, the forensic expertise considers their contents and indicates the flaws in their development, for example: absence of creation date, signatures, name of the document, initial number, etc.

The second part of the research-analytical stage is detecting and analyzing the flaws in organizing and conducting VSMs (Fig. 3).

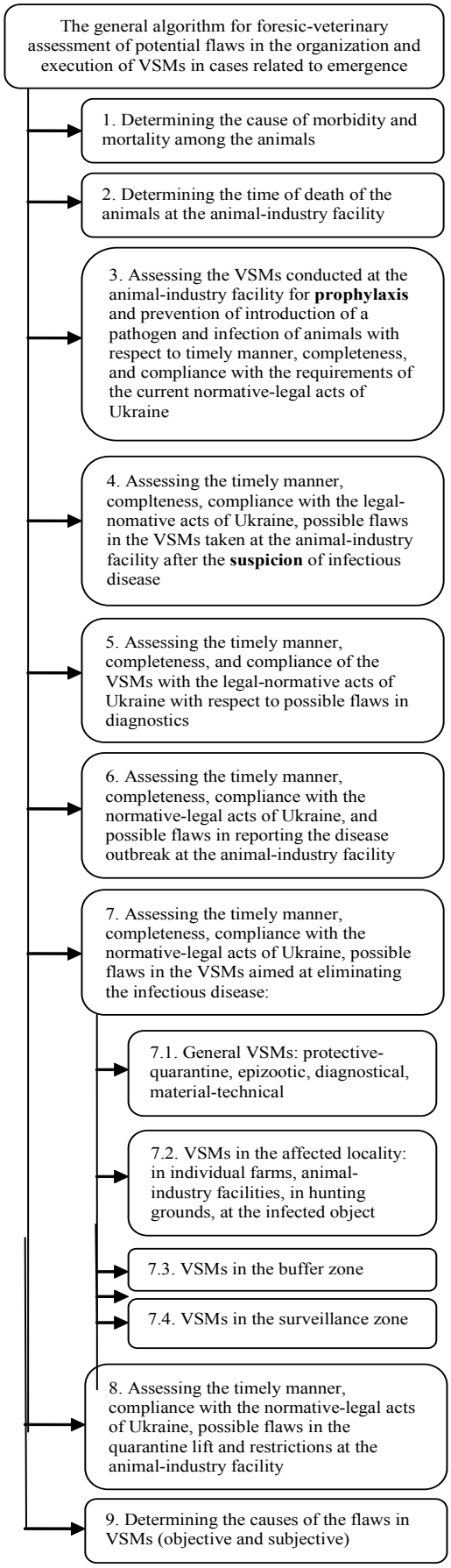

Fig. 3. The general algorithm for forensic-veterinary assessment of possible flaws in the organization and execution of VSMs during investigations of cases related to infection outbreak at the research-analytical stage of FVE

The variety of manifestations of flaws in organizing and conducting VSMs that had caused the emergence and spread of infectious diseases in animals, their relation to multiple facets of professional veterinary work requires a complex approach. Moreover, those flaws need a scientifically substantiated classification. The classification aids in systematizing the objects of forensic expertise and facilitates scientific analysis of their properties, both separately and interrelated with one another. Scientifically substantiated grouping of classification features of the flaws in organizing and conducting VSMs that had caused the emergence and spread of infectious diseases in animals can have important gnoseological significance, and are therefore of practical importance to FVE. For a complex assessment of all aspects that can contribute to the formation of flaws in VSMs, the authors propose the following classification:

1. Failures in VSMs by type and subject of activity:
– organizational;
– document management;
– protective-quarantine;
– epizootological;
– diagnostic;
– material-technological;
– deontological.

2. Flaws in VSMs according to time periods and extent of their implementation:
– insufficiency;
– not implemented in time;
– incorrectness;
– lack of organization and implementation.

3. Flaws in documenting VSMs:
A) by quantity of documents:
– incomplete quantity;
– absence of documents.
B) by content of veterinary documents:
– absence of signatures of individual participants;
– absence of names of quarantine outposts;
– absence of names of affected locations;
– ambiguous designation of settlements within quarantine zones
– absence of address where the VSMs had been conducted.

4. Diagnostic flaws:
– diagnosing using a method other than polymerase-chain reaction (PCR);
– conducting the diagnostic study in a non-certified laboratory;
– not identifying the molecular characterization of the infection pathogen;
– flaws in selecting pathological material;
– flaws in transferring pathological material to the laboratory;
– flaws in sample information sheets.

5. Flaws in prevention of introduction of infectious-disease pathogens:
– flaws in prohibitions of delivering objects from territories that are unfavorable in terms of infectious diseases, etc.;
– flaws in the judicial and physical persons' control of adherence to the requirements to VSMs during international transfers of objects of state veterinary-sanitary control;
– flaws in the judicial and physical persons' control of adherence to the requirements of VSMs while importing objects of state veterinary-sanitary control;
– flaws in the animal-industry facilities' control of adherence to the requirements of restricted working regime;
– flaws made by authorized bodies in identifying animal-industry facilities with high level of biosafety.

6. Flaws in VSMs in case of suspicion of infectious disease:
– flaws in notifying the authorized officials;
– flaws in identifying the epizootic situation and execution of epizootic investigation;
– lack of awareness regarding an introduction of infection pathogen to the territory of animal-industry facilities of other regions;
– flaws in accounting the animal population at the animal-industry facility and in human settlements (diseased and likely infected animals);

– flaws in treatment of animals (isolation, re-grouping, slaughter, transportation, and selling of animals);

– flaws in organization and execution of disinfection.

7. Flaws in general VSMs while eliminating infectious diseases:

– flaws in adopting a decision by SEAEC regarding announcement of outbreak of infectious disease, enforcing lockdown, determining boundaries of outbreak (affected locality), zones of protection and surveillance (monitoring);

– flaws in organizing VSMs: protecting-quarantine, epizootic, diagnostic, and material-technical;

– flaws in the work of SEAEC aimed at the prevention of spread and elimination of infectious diseases of animals;

8. Flaws in identifying the limits of territorial zones of control of infectious diseases:

– boundaries of outbreak (affected locality);

– boundaries of protection;

– surveillance zones (monitoring).

9. Flaws in VSMs at individual farms in the zone of affected locality:

– flaws in creating groups for removing ill and dead animals;

– flaws in timely culling, conducting slaughter, and burning of animal corpses;

– flaws in rat-infestation removal at the farm;

– flaws in disinfection of means of transportation used in the VSMs;

10. Flaws in VSMs at animal-industry facilities:

– flaws in organization and operation of quarantine outpost;

– flaws in determining warning signs;

– flaws in sanitizing the transport moving out of the hotbed of infection (unfavorable location) and also people's footwear;

– flaws in sanitary-hygienic treatment of persons involved in performing VSMs and those that visited the hotbed (affected locality);

– flaws in working instructions for those involved in VSMs;

– flaws in providing the necessary technical and disinfecting means for carrying out the planned VSMs;

– flaws in compliance with the restrictions at animal-industry facilities (individual farms);

11. Flaws in VSMs at hunting grounds:

– flaws in eliminating carcasses of wild animals shot , animal corpses, and disposable special clothes for veterinary experts;

– flaws in disinfection of transport used in VSMs;

– flaws in disinfecting special clothes and footwear used in VSMs;

– flaws in determining the number of wild animals at hunting grounds;

– flaws in forming groups for monitoring and collection (in case of discovery) of corpses of wild animals in the territory of hunting grounds with the purpose of their further elimination.

12. Flaws in VSMs at disease-infested object:

– flaws in dispatching all susceptible animals and burning their corpses;

– flaws in processing the corpses and subproducts with no risk of infection or contamination;

– flaws in cleaning, disinfection, and pest control at the premises, as well as sanitization of equipment and means of transportation;

– flaws in sanitizing places (landfills, pastures, windbreaks, etc.) where infected corpses or animal remains had been found;

– flaws in conducting epizootic investigation;

– flaws in conducting VSMs at animal-industry facilities (individual farms) where infected animals and/or corpses had been found.

13. Flaws in VSMs in the buffer zone:

– flaws in accounting for the total swine population at animal-industry facilities of all forms of ownership (individual farms);

– flaws in slaughtering all clinically healthy animal population at farms of the buffer zone in a place determined by the SEAEC and use of carcasses after conducing laboratory studies;

– flaws in dispatching animals with the signs of disease and burning their corpses in a place determined by SEAEC;

– flaws in restrictions in the buffer zone according to the Instruction On Prophylaxis and Control of Infectious Diseases.

14. Flaws in lifting quarantine:

– violations of the term of quarantine;

– lifting quarantine after conducting an incomplete complex of final VSMs;

– lifting quarantine without a decision of the SEAEC;

– violating periods of delivering animals to an affected farm, i.e. before the completion of operations of cleaning, disinfecting, rat-infestation removal, and pest control at the animal-industry facilities of all forms of ownership (individual farms);

– Delivering animals to an animal-industry facility without a preliminary delivery of indicatory animals;

– Lifting quarantine without checking the animals for the presence of antibodies to pathogen of the infectious disease;

– Transferring animals out of the animal-industry facilities (individual farms) prior to obtaining negative results of serological studies;

– Complete recovery of the animal population at animal-industry facility if antibodies to the infectious-disease pathogen had been found;

– Permitting the individual farms where cases of infectious disease had been found to rear animals earlier than established in the instruction on prophylaxis and control of infectious disease after lifting quarantine, without conducting the required VSMs.

The proposed list of flaws can be expanded and amended depending on the normative requirements of policies regarding prophylaxis and control of particular infectious diseases and other normative requirements.

The results of the research-analytical stage are decisive for determining the potential flaws in organizing and conducting VSMs in cases related to emergence and spread of infectious diseases in animals, determining their causes, assessing the effectiveness of organization, prophylaxis, and diagnostic events oriented at the prevention of emergence of infectious diseases, and also promote objective assessment of timely implementation, correctness, completeness, rationale, and adequacy of the chosen diagnostic and health-improving tactics.

The quality of VSMs can also be evaluated by analyzing current specialized instructions on prophylaxis and control of infectious diseases, and instructions for officials and experts in veterinary medicine whose duties include conducting VSMs.

Generalizing-evaluating stage

At the fourth stage of expertise, the results of studies of the materials and records are generalized and evaluated in order to identify the potential flaws in organizing and conducting VSMs. For this purpose, it is practical to use the dialectical method and methods of formal logic, in particular, analysis, synthesis, deduction, induction, and modeling. Thus, the forensic expert forms an internal belief as a foundation for conclusions: those results are a synthesizing part of the research leading to the expert's conclusion.

Considering the significance of the generalizing-evaluating stage in the system of research and evaluation of potential flaws in VSMs, the forensic-veterinary commission of experts:

– Generalizes the results obtained at previous stages of forensic-veterinary study of flaws in VSMs;

– Analytically assesses the presence and variance of alternatives;

– Provides an expert assessment of the data obtained at the research-analytical stage (work related to proper or improper conduct of professional duties by veterinarians), and concludes on their informativeness (informative, low-informative, not informative) and their suitability for drawing the final conclusions as answers to the questions that the forensic expert commission had to address;

– Determines whether the flaws in VSMs had actually inflicted harm to the animals and humans or had been the most likely causes of the negative impacts on their health.

To generalize and evaluate the conducted VSMs in cases related to emergence and spread of epizootics (pantozootics), the authors of this report propose the algorithm presented in Figure 4.

1) Finding the presence or absence of individual documents (veterinary and SEAEC) in the materials of criminal proceeding that confirm or refute the fact of VSMs being conducted against certain infec-

tious diseases of animals, for example, disinfections of transport, rat-infestation removals, burning animal bodies, etc. Absence of documents should be considered a lack of confirmation of conducting a particular VS measure.

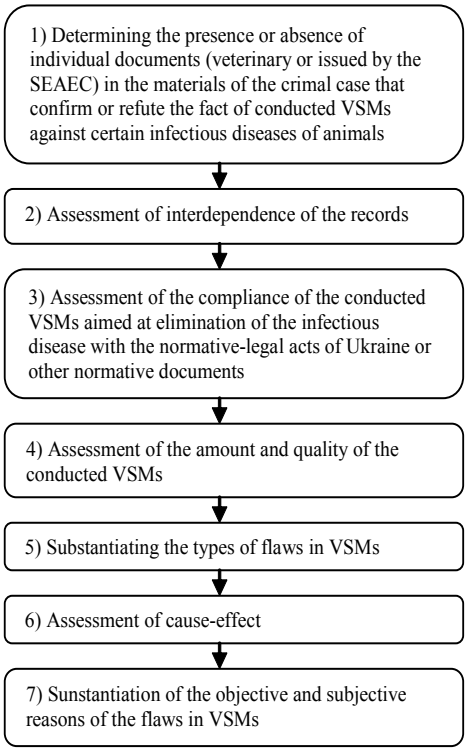

Fig. 4. Algorithm for evaluating the conducted VSMs and identifying possible flaws during the emergence and spread of epizootic (panzootic)

2) Assessing the interdependence of records. For example, in the case of an outbreak of anthrax, according to the Provision 3.11 of the Instruction on Measures of Prophylaxis and Control of Anthrax (adopted by the order of the State Department of Veterinary Medicine of Ministry of Agrarian Policy and Food of Ukraine as of January 25, 2000, No. 4); the Plan of Organizational, Veterinary-Sanitary, and Economic Measures for Eliminating Hotbed of Anthrax and Prevention of Spread of Infection in the Territory of the District, approved by the SEAEC, such VSMs are required as removal and burning corpses of animals that had died of anthrax. Therefore, the absence of an act confirming carrying out such measures in the materials of a criminal proceeding would be a violation/lapse in security.

3) Evaluation of the compliance of conducted VSMs for eliminating infectious disease to the normative-legal acts of Ukraine or other normative documents. We consider that to evaluate the results, VSMs should be arranged in three groups: fully comply, partly comply, and do not comply with the requirements of the normative-legal acts and normative documents. We illustrate the grouped parameters obtained from own forensic-veterinary practice on the example of anthrax (Table 1).

4) Evaluation of the extent and quality of conducted VSMs. To assess the extent of VSMs, the experts analyze their completeness and timely manner of execution, and to assess their quality, their correctness and effectiveness are considered. Therefore, the completeness of VSMs is defined by the criteria such as:

– the extent: quantity, repetition, intervals (for example, disinfection, pest control, rat-infestation removal, etc.). Insufficient extent of VSMs is their execution to an extent lower than required; inappropriately; not in compliance with certain requirements; unsatisfactory, poorly;

– timely manner (measure taken when needed, timely, appropriate, relevant, in compliance with the normative documents). Non-timely manner of organization and execution of VSMs refers to the delay or inadequacy in implementing health and safety protocols aimed at preventing, controlling, or monitoring animal health issues.

Table 1
Conformity of the veterinary-sanitary measures on individual farms at a locality affected by the African swine fever virus to the institutional Instruction (approved by the Order of the Ministry of Agrarian Policy and Food of Ukraine as of March 3, 2017)

No.	Requirements of the institutional Instruction for VSMs at individual farms at a locality affected by the African swine fever virus	Veterinary-sanitary measures taken at individual farms at a locality affected by the African swine fever virus	Compliance or non-compliance with the requirements of the institutional Instruction
1	Removal, killing, and burning of all swine at the outbreak location (affected locality) (Point 6.2.2)	Removal, killing, and burning of all swine at the outbreak location (affected locality) (Act as of (*date*))	Conforms to 6.2.2 of the institutional Instruction
2	Burial of swine corpses at a site approved by the SEAEC at the depth of no less than two meters (in case burning is impossible) (Point 6.2.2)	Swine corpses are buried at the site at a site approved by the SEAEC at the depth of one meter (Act as of (*date*))	Non-compliance with 6.2.2 of the institutional Instruction
3	Disinfecting all the special clothes and footwear of the personnel involved in the measures. Burning of the disposable clothes (Point 6.2.6)	Acts as of (date) regarding the disinfection of special clothes and footwear of the personnel involved in the measures. Act regarding burning of disposable clothes in the materials of criminal case is absent	Partially complies with Point 6.2.6 of the institutional Instruction

– The quality of the conducted VSMs is measured by the criteria of correctness and efficiency:

– Correctness (faultlessness, adherence to the established norms and rules). Incorrect tactics of organization and execution of VSMs is non-compliance with certain norms, rules, requirements, actual circumstances, and reality; errors, incorrectness; not contributing to the desired results;

– Efficiency (actual ratio between the VSMs conducted and the desired outcomes), in particular, the results of events conducted for prophylaxis of introduction of infectious diseases, measures taken in case of suspicion of disease, execution of diagnostic procedures; measures aimed at elimination of disease, designating general organizing measures, events in an affected locality, in the buffer zone and zone of surveillance zone; rationale for lifting quarantine;

– Non-application of VSMs – inaction by officials and veterinary-medicine professions, despite the fact that organizing and carrying out VSMs are their duties.

The extent and quality of conducted VSMs in cases of infectious diseases are evaluated separately and in total sum of protective-quarantine, epizootological, diagnostic, and material-technical measures. At the same time, we should clarify that protective-quarantine measures are assessed according to the criteria of localizing the hotbed of infection and enforcing quarantine measures for prevention spread of the disease.

Anti-epizootic measures are evaluated according to the parameters of quality of monitoring the epizootic hotbeds and infected objects, quality of control over the epizootic situation, and development and control of executing VSMs to eliminate the disease.

Diagnostic measures are evaluated according to the quality of the procedure of sampling the pathological material from sick or diseased animals and its delivery to the State Scientific-Research Institute of Laboratory Diagnostics and Veterinary-Sanitary Expertise (Kyiv) or other authorized or certified state laboratories of veterinary medicine. At the same time, we should note that at the stage of assessing the diagnostic procedures in the system of VSMs, the forensic-expert commission must substantiate the correctness of the diagnosis of infectious disease. If the experts find that the materials of the criminal proceeding lack documents confirming the execution of diagnostics of

infectious disease in a state-certified or authorized laboratory, the credibility of the diagnosis may be called into question, thus being a diagnostic flaw.

The material-technical measures are assessed according to the following features: provision of equipment for disinfection, means for eliminating the infection hotbed (machinery, equipment, chemical means, etc.), and means of individual protection of people working at the epizootic hotbed.

5) Substantiation of the types of flaws in VSMs. Obviously, in the case of establishing flaws in VSMs due to veterinary-medicine professional(s)'s practice, the forensic-expert commission must indicate the type(s) of such flaw(s) based on the classification we proposed. For example, "the forensic-veterinary expertise found the flaw in processing carcasses and subproducts that posed risk of infection or contamination". Also, we should note that in each case, the forensic-veterinary expert's conclusions must contain substantiations of what specifically was the flaw in the work of veterinarians in the particular circumstances of organizing and carrying out VSMs.

6) Evaluation of cause-effect between:

– engagement or lack of engagement by veterinary-medicine professionals and the emergence of flaws in VSMs;

– emergence of flaws in VSMs and their negative consequences. The latter include loss of animal productivity as a result of their deterioration of their wellbeing or death due to infectious disease; illness and death of people from zooanthroponoses/reverse zoonosis; economic losses related to the organization and execution of protective-quarantine, epizootic, diagnostic, and material-technical measures during an outbreak of infectious disease;

7) Substantiation of objective and subjective reasons for the flaws in VSMs, conducted by an expert in the sphere of forensic-veterinary expertise, would obviously promote the adoption of operative, well-grounded, and just decisions both during a pre-trial investigation of violation of veterinary rules and at the stage of court hearings of a criminal proceeding (case).

Exclusively the evidence-based veterinary medicine and FVE can serve as the means of scientific substantiation for improper (flawed) practice of veterinary professionals who by neglecting their duties had caused an emergence and spread of infectious diseases of animals, in particular emerging diseases.

During criminal proceedings related to outbreaks of infectious diseases, in particular, looking into whether the veterinary rules had been violated, especially, organizing and executing veterinary-sanitary measures, there is a need for a comprehensive, unbiased, objective, and well-grounded evaluation of documents. For this reason, the forensic-veterinary expert commission has to employ the highest possible extent of special knowledge in veterinary medicine and its own experience in conducting a correct substantiation of answers to the questions put forward in the procedural document about assigning forensic-veterinary expertise of potential flaws in VSMs and their contribution to the emergence and spread of epizootics and panzootics.

Therefore, the materials provided for analysis are generalized and assessed in the following sequence: drawing intermediate conclusions, solving the questions regarding their interdependence, and logically analyzing all those matters in combination to determine the patterns in the formation of flaws in VSMs against infectious diseases of animals.

Final stage

This stage of FVE for determining potential flaws in VSMs is the commission of forensic-veterinary experts drawing final conclusions and formulating Experts' Conclusions as a procedural document that finalizes the forensic expertise. The results of the conducted research should be discussed at a general council of the expert commission.

The objects for analysis (mostly, veterinary documents, documents from the SEAEC and government bodies, for example, protocols of investigating the incident location, scheme, photos, video footage, etc.) must be provided to the commission in the order established in the legislation and pertain to the subject of FVE. The commission concludes on their sufficiency, informativeness, and the potential for drawing conclusions about whether the suspected violations had taken place. Also, the experts' comprehensive, objective, and direct study of both individual objects and their interrelation, and also of the relationship with other materials of criminal proceeding, must produce results that are sufficient to provide well-grounded conclusions. The expert commission must have no doubts regarding the correctness of its decision and must be ready to act accordingly.

The adjudication Experts' Conclusions includes the results of studying records (veterinary documents, organizational documents and orders from bodies of power), emphasizing the detected flaws in VSMs that contributed to an outbreak of infectious disease, providing arguments for their rationale, extent, and persuasiveness. The final conclusions must categorically or with a high certainty answer the questions set forward to the FVE in the procedural document about its assignment.

There are enough reasons for formulating final results in a categorical form, since in this sphere of veterinary activity there are institutions' instructions regarding prophylaxis and control of certain infectious diseases. Therefore, to assess the adherence of VSMs to the requirements while investigating a case related to an outbreak of infectious diseases, for an expert commission, it would be enough to study the provided materials such as veterinary documents, organizational documents, and orders from bodies of power during organization of VSMs for the purpose of prophylaxis of introduction of infectious-disease pathogen, diagnostic measures, measures for eliminating disease, and improving wellbeing at animal industries (individual farms).

We should especially note that the expert commission determines whether the conducted VSMs conformed or not to the normative requirements of, for example, instruction for prophylaxis and control of a certain infectious disease. At the same time, we should note that forensic-expert commission does not indicate whether the conducted VSMs had been violations of provisions in the instructions, since determining whether a violation occurred is the function of law-enforcing agencies, and is provided in a final ruling in the court conviction.

The finalizing stage of conducting a commission FVE is completed by developing Experts' Conclusions or Report on the Impossibility of Providing a Conclusion (in cases when experts do not receive objects for research or additional materials if requested). The forensic expert who is the reporter in the case develops a project of final conclusions with answers to the question established in the decision of forensic-expert commission in the rule of the court or decree of the subject of commission FVE assignment (involvement of experts), composes the project Experts' Conclusions or Report on the Impossibility of Providing a Conclusion; provides the FVE commission's conclusions, signed by the members of expert commission, to the heads of units and the leading forensic-expertise institution for consideration.

Leaving aside further theoretical polemics regarding the specifics of content of each part of the experts' conclusion, we consider it important to emphasize that the introductory part is the results of expert research, obtained at the introductory-preparatory and organizational-informative stages; the research part of Experts' Conclusions should comprise the results of the study obtained at the research-analytical and generalizing-evaluating stages, while the final conclusions must be inferred from the data analyzed and evaluated by the experts. If the forensic-expert commission comes to the conclusion that an organization and execution of VSMs had flaws that led to negative economic, epidemiological, and epizootic social consequences, then the final conclusions must indicate the reasons for the detrimental implications of flawed VSMs.

The number of questions in the final conclusions must match the number of questions in the procedural document on commission FVE assignment, in rare exception when questions the same type can be grouped. The answers must be objective, well-grounded, complete, with unambiguous interpretation, concise, and terminologically understandable.

Experts' Conclusions are written on a form of the expert institute-on, and must be signed by the members of the expert commission who participated in the research. Their signatures are confirmed by

the stamp of the expert institution. Photo tables as illustrative material are signed by the forensic experts (Provision 4.15 of Section 4 of the specialized Instruction).

Discussion

Ukraine, similarly to other countries of the world, periodically faces highly contagious and acute infectious diseases of animals, for example, African swine fever virus, classical swine fever, highly pathogenic avian influenza, swine influenza, etc. Thus, organization and execution of VSMs are integral components of effective farming at both industrial facilities and individual farms, ensuring the country's veterinary wellbeing and public health (Alcala et al., 2020). Sanitation procedures are safeguards for people against zoonotic diseases (Kozytska et al., 2023). They also reliably protect animal farming from losses caused by productivity decreases and treatment of sick animals (Alishov, 2017; Hulak et al., 2023) and their mass death (Liu et al., 2021). Veterinary-sanitary measures also preclude the spread of causative agents of contagious diseases in the environment (Neo, J. P. S. & Tan, B. H., 2017; Donachie D. et al., 2023). Therefore, Ukrainian and foreign legislation contains norms regulating the process of adopting and enforcing VSMs, among others, the Law of Ukraine on Veterinary Medicine: Law of Ukraine as of June 25, 1992, No. 2498-XII. https://zakon.rada.gov.ua/laws/show/2498-12#Text), the Law of Ukraine on Ensuring the Sanitary and Epidemic Well-being of the Population: Law of Ukraine as of February 24, 1994, No. 4004-XII. URL: https://zakon.rada.gov.ua/laws/show/4004-12#Text), etc.

Moreover, malpractice in organization and execution of VSMs can be a cause of biological threats to people, as pointed out by both Ukrainian (Zadorozhna et al., 2024) and foreign researchers (Novossiolova et al., 2021; Renault et al., 2021; Sushma et al., 2021).

Deliberate or accidental deviations from the regulations of normative procedures in organizing and carrying out VSMs, flaws such as inaction or malpractice by veterinary-medicine professionals or authorized persons in relation to decrees, often entail outbreaks of infectious diseases, especially highly contagious and acute ones. Threats of various nature posed by such diseases, and also significant economic losses caused to animal farming and the environment, require criminal investigation of criminal violations of veterinary rules (according to Article 251 of the Criminal Code of Ukraine), and identifying those guilty of violating VSMs (Collyer, 2017; Rømo, 2024; Schirdewahn et al., 2021).

For an objective and unbiased establishment of the factual data and circumstances surrounding the emergence and mass spread of infectious diseases in animals, the investigating bodies and court employ special knowledge in veterinary medicine in the form of forensic-veterinary expertise (Munro, 2022; Uddin et al., 2022). Based on the analysis of forensic-expert practice, we may confidently state that it is the competence of a forensic-veterinary expert, within a criminal procedure, which determines the adequacy of VSMs in particular circumstances. This assessment is made based on criteria such as timely manner of their application, correctness, effectiveness, completeness, rationale, type of flaws (organizational, document circulation, protective-quarantine, epizootological, diagnostic, material-technical, deontological, etc), and most importantly adherence to the normative-legal acts of Ukraine that regulate the respective VSMs in the case of emergence and spread of infectious diseases in animals.

As of now, the authors of this paper have for the first time in Ukraine developed the general methodological approaches to conducting forensic-veterinary expertise of flaws in organizing and executing VSMs, used by forensic experts in the system of the Ministry of Justice of Ukraine.

It has to be noted that as the requirements regarding organization of FVE become stricter, as one of the main sources of evidences in court, in particular, in case of violation of veterinary rules, the authors of this article emphasize the key problems that arise due to flawed conduct of professional duties by veterinary-medicine professionals through the prism of FVE. The problems we highlighted negatively affect evidence presentation, absence of bias, objectivity, and the correctness of the conclusions from forensic experts, negatively affect the certainty of law enforcement agencies and court, and therefore affect the issuing of well-grounded and justified legal decisions.

Our own experience of forensic-veterinary assessment of flaws in VSMs indicates the ways of solving the outlined problems:

– Continuous improvement of the Instructions on Prophylaxis and Control of Infectious Diseases based on novel scientific and technological achievements taking into account the dynamics of veterinary concepts, postulates, and positions of theoretic and clinical veterinary medicine;

– Training students of law faculties, who are studying the speciality 081 'Law', in the discipline 'Forensic Veterinary Medicine', thereby enhancing their expert preparation for investigation of criminal cases related to violations of veterinary rules, particularly, in collaboration with a special subject – worker of veterinary medicine, in cases of emergence and spread of infectious diseases of animals;

– Initiation of the involvement of veterinary-medicine experts (especially those who specialize in spheres such as microbiology, virology, mycology, epizootiology, sanitary engineering, parasitology, etc.), and also forensic-veterinary experts in investigating cases regarding flawed organization and execution of VSMs and professional cooperation with them;

– As of now, the State Service of Food Safety has created an advisory body of veterinary experts, which law enforcement agencies or courts can involve for consultations during investigations of crimes related to veterinary rules (Article 251 of CCU) with the special subject – worker of veterinary medicine, in particular, while investigating cases of emergence and spread of infectious diseases for assessing organization and execution of VSMs;

– Expansion of Section 10 of the Scientific-Methodological Recommendations for the Issues of Preparation and Appointment of Forensic Expertise and Expert Studies (Scientific-Methodological Recommendations <…>, 1998) with a collection of formulated questions regarding flaws in organization and execution of VSMs during investigations of cases of emergence and spread of infectious diseases. Those questions can be put forward by the subject of FVE assignment to a commission of forensic-veterinary experts to solve.

To sum up, we should note that such developments positively influence the efficiency of execution and productivity of FVE; the possibility for forensic experts to provide well-grounded and objective conclusion as the means of presenting evidences in court of law in categorical form; expand the research abilities of the bodies of pretrial investigation and the courts; and become a basis for improvements in the criminal and administrative legislation of Ukraine.

Conclusions

We have proposed our five-stage methodology for FVE to detect possible flaws in organizing and executing SVMs in investigations of cases of emergence and spread of infectious diseases in animals. It comprises five stages: 1) familiarizing-preparatory, 2) organizational-informative, 3) research-analytical, 4) generalizing-evaluating, and 5) final. Those stages reflect the sequence of actions by a commission of forensic-veterinary experts during forensic investigation, shine light on all the main questions that must be answered for a factual research of circumstances in which epizootic/pantzootic infections had emerged and spread, revealing their subjective and objective factors that reinforced each other. Each previous stage is the basis for the next one, and the conclusions of a commission of forensic-veterinary experts with regards to possible flaws in VSMs are enriched with information and become better grounded.

It was confirmed that using the proposed methods in FVE practice would promote effective identification of flaws in VSM elements (flaws in documenting VSMs; diagnostic flaws; flaws in VSMs aimed at prophylaxis and prevention of introduction of pathogens of infectious diseases; flaws in VSMs following suspicions of infectious diseases; flaws in identification of the territorial boundaries of control zones; flaws in VSMs at an individual farm, the zone of outbreak (affected locality), at animal-industry facilities, at hunting grounds, with infection-affected objects, in a buffer zone; flaws in lifting quarantine) with compulsory consideration of objective and subjective factors that

had caused them. During FVE, the expert commission has to prove, beyond a reasonable doubt, the presence of flaws in VSMs during epizootic (panzootic) due to internal findings. It also must justify its conclusions about the presence or absence of individual documents in materials of criminal proceeding that confirm or refute the fact of VSMs being conducted against certain infectious diseases in animals; interdependency of the records; compliance or non-compliance of the conducted VSMs for eliminating infection diseases with the requirements of normative-legal acts of Ukraine or other normative documents; extent and quality of conducted VSMs; types of flaws in VSMs; cause-effect relationships between the emergence and spread of epizootics (panzootics) on the one hand and flaws in VSMs on the other hand; and also objective and subjective causes of the flaws in VSMs.

The forensic-veterinary expert commission has to assess the timely manner, correctness, extent, rationale, effectiveness, and correspondence of VSMs to the normative requirements.

The method that the authors have developed for forensic expertise of violating veterinary rules due to flaws in organizing and executing VSMs, which led to emergence and spread of infectious diseases in animals, in the practice of forensic-veterinary expertise would facilitate:

– Finding the signs of illegal activity or inactivity by veterinary-medicine workers or the SEAEC that had caused emergence and spread of infectious diseases in animals;

– Determining cause-effect relations between activity or inactivity of veterinary-medicine workers (SEAEC) and their consequences, i.e. determining the objective aspect of the violation;

– Determining whether there were actual possibilities for the workers in veterinary medicine to predict hazardous (negative) consequences of their activity or inactivity, i.e. determining the subjective aspect of violation;

– Evaluating harmful (negative) consequences of epizootics or panzootics, and also determining their objective and subjective causes.

The developed conceptual foundations of conducting forensic expert investigation of the flaws in organizing and executing VSMs against epizootics or panzootics would enrich the science of forensic-expertise and practice with novel unified opportunities, will become the scientific basis for providing well-grounded conclusions from experts in a categorical form; create the foundation for improving the criminal and administrative legislation of Ukraine concerning the judicial responsibility of workers in veterinary medicine for violating veterinary rules, and also regarding quarantine of animals and other veterinary-sanitary requirements.

References

Alcala, R., Vitikkala, H., & Ferlet, G. (2020). The World Trade Organization agreement on the application of sanitary and phytosanitary measures and veterinary control procedures. Revue Scientifique et Technique, 39(1), 253–261.

Alishov, H. N. (2017). Prodovol′cha bezpeka Ukrayiny ta chynnyky, shcho formuyut′ yiyi riven′ [Food security of Ukraine and factors shaping its level]. Economy and Society, 13, 164–168 (in Ukrainian).

Andreychyn, M. (2022). Emerdzhentni ta reemerdzhentni infektsiyni khvoroby: Aktualizatsiya znan′ v entsyklopedychnykh vydannyakh [Emerging and reemerging infectious diseases: Content update in encyclopedias]. The Encyclopedia Herald of Ukraine, 14, 37–42 (in Ukrainian).

Andreychyn, M. A. (2019). Problema infektsiynykh infektsiy v Ukrayini [The problem of infectious diseases in Ukraine. Infectious Diseases]. Infektsiyni Khvoroby, 98, 4–9 (in Ukrainian).

Bashchenko, M. I., Stehniy, B. T., Herilovych, A. P., & Baranovskyy, D. I. (2017). Problemy i perspektyvy rozvytku standartiv biolohichnoyi bezpeky ta biolohichnoho zakhystu u veterynarniy medytsyni ta biotekhnolohiyi [Problems and prospects for the development of standards of biological safety and biological protection in veterinary medicine and biotechnology]. Veterinary Medicine, 103, 8–12 (in Ukrainian).

Bohach, M. V., Selishcheva, N. V., Lyzohub, L. Y., & Stehniy, O. O. (2020). Epizootychna sytuatsiya shchodo osoblyvo nebezpechnykh virusnykh infektsiy sered ptakhiv pivdnya Ukrayiny [Epizootic situation concerning particularly dangerous viral infections among birds in Southern Ukraine]. Veterynarna Medytsyna, 106, 15–18 (in Ukrainian).

Brown, V. R., Miller, R. S., McKee, S. C., Ernst, K. H., Didero, N. M., Maison, R. M., Grady, M. J., & Shwiff, S. A. (2021). Risks of introduction and economic consequences associated with African swine fever, classical swine fever and foot-and-mouth disease: A review of the literature. Transboundary and Emerging Diseases, 68(4), 1910–1965.

Caceres, P., Awada, L., Weber-Vintzel, L., Morales, R., Meske, M. & Tizzani, P. (2023). The World Animal Health Information System as a tool to support decision-making and research in animal health. Scientific and Technical Review, 42, 242–251.

Caceres, P., Tizzani, P., Ntsama, F., & Mora, R. (2020). The World Organisation for Animal Health: Notification of animal diseases. Revue Scientifique et Technique, 39(10), 289–297.

Calkins, C. M., & Scasta, J. D. (2020). Transboundary animal diseases (TADs) affecting domestic and wild African ungulates: African swine fever, foot and mouth disease, Rift Valley fever (1996–2018). Research in Veterinary Science, 131, 69–77.

Charostad, J., Rukerd, M. R. Z., Mahmoudvand, S., Bashash, D., Hashemi, S. M. A., Nakhaie, M., & Zandi, K. (2023). A comprehensive review of highly pathogenic avian influenza (HPAI) H5N1: An imminent threat at doorstep. Travel Medicine and Infectious Disease, 55, 102638.

Clemmons, E. A., Alfson, K. J., & Dutton 3rd, J. W. (2021). Transboundary animal diseases, an overview of 17 diseases with potential for global spread and serious consequences. Animals, 11(7), 2039.

Collyer G. (2017). Links between law enforcement and veterinary animal health: A case study of the United Kingdom and the United States of America. Revue Scientifique et Technique, 36(2), 549–556.

Donachie, D., Ewann, F., & Poudevigne, F. (2023). Animal agrocrime: An overlooked biological threat. Health Security, 21(5), 415–420.

Endalew, A. D., Faburay, B., Wilson, W. C., & Richt, J. A. (2019). Schmallenberg disease – a newly emerged culicoides-borne viral disease of ruminants. Viruses, 11(11), 1065.

Eom, H. J., Lee, E.-S., & Yoo, H. S. (2023). Lumpy skin disease as an emerging infectious disease. Journal of Veterinary Science, 24(3), e42.

Gongal, G., Rahman, H., Thakuri, K. C., & Vijayalakshmy, K. (2022). An overview of transboundary animal diseases of viral origin in South Asia: What needs to be done? Veterinary Sciences, 9(11), 586.

Gortázar, C., Barroso, P., Nova, R., & Cáceres, G. (2022). The role of wildlife in the epidemiology and control of foot-and-mouth-disease and similar transboundary (FAST) animal diseases: A review. Transboundary and Emerging Diseases, 69(5), 2462–2473.

Hernandez-Jover, M., Davis, E., Hayes, L., Manyweathers, J., Maru, Y., & Woodgate, R. (2024). Contribution of the veterinary profession to the Australian animal health surveillance system and opportunities for future contributions. Preventive Veterinary Medicine, 226, 106172.

Hulak, O. V., Piddubnyy O. Y., & Ladychenko V. V. (2023). Karantyn tvaryn v konteksti prodovol′choyi bezpeky: pravovyy aspekt [Animal quarantine in the context of food security: legal aspect]. Naukovi Zapysky, Seriya: Pravo, 14, 50–54.

Hunter, P. (2022). Europe's worst ever bird flu outbreak: This year's epidemic of highly pathogenic avian flu has had a devastating impact on wild and domestic birds and severe economic consequences. EMBO Reports, 23, e56048.

Kozytska, T., Bassiouny, M., Chechet, O., Ordynska, D., Galante, D., Neubauer, H., & Wareth, G. (2023). Retrospective analysis of official data on anthrax in Europe with a special reference to Ukraine. Microorganisms, 11(5), 1294.

Kozytska, T., Bassiouny, M., Chechet, O., Ordynska, D., Galante, D., Neubauer, H., & Wareth, G. (2023). Retrospective analysis of official data on anthrax in Europe with a special reference to Ukraine. Microorganisms, 11(5), 1294.

Lewis, C. E., & Roth, J. A. (2021). Challenges in having vaccines available to control transboundary diseases of livestock. Current Issues in Molecular Biology, 42, 1–40.

Li, Y., & Robertson, I. (2021). The epidemiology of swine influenza. Animal Diseases, 1(1), 21.

Liu, Y., Zhang, X., Qi, W., Yang, Y., Liu, Z., An, T., Wu, X., & Chen, J. (2021). Prevention and control strategies of African Swine Fever and progress on pig farm repopulation in China. Viruses, 13(12), 2552.

Lubroth, J. (2024). The global framework for the progressive control of transboundary animal diseases – strengthening infectious disease management and veterinary systems across the continents: Origins and testimony. The Veterinary Clinics of North America. Food Animal Practice, 40(2), 233–249.

Ly H. (2024). Highly pathogenic avian influenza H5N1 virus infections of dairy cattle and livestock handlers in the United States of America. Virulence, 15(1), 2343931.

Marchetti, C., Mastrogiuseppe, L., Vanin, S., Cecchi, R., & Gherardi, M. (2023). On-site inspection form in veterinary cases: The parma veterinary form. Animals, 13(13), 2064.

Moudgil, G., Chadha, J., Khullar, L., Chhibber, S., & Harjai, K. (2024). Lumpy skin disease: Insights into current status and geographical expansion of a transboundary viral disease. Microbial Pathogenesis, 186, 106485.
Munro R. (2022). Viewpoint: Integrity and limitations of forensic veterinary evidence. Journal of Comparative Pathology, 199, 86–87.
Neo, J. P. S., & Tan, B. H. (2017). The use of animals as a surveillance tool for monitoring environmental health hazards, human health hazards and bioterrorism. Veterinary Microbiology, 203, 40–48.
Novossiolova, T. A., Whitby, S., Dando, M., & Pearson, G. S. (2021). The vital importance of a web of prevention for effective biosafety and biosecurity in the twenty-first century. One Health Outlook, 3(1), 17.
Qiu, Y., Guitian, J., Webster, J. P., Musallam, I., Haider, N., Drewe, J. A., & Song, J. (2023). Global prioritization of endemic zoonotic diseases for conducting surveillance in domestic animals to protect public health. Philosophical Transactions of the Royal Society of London. Series B, Biological sciences, 378(1887), 20220407.
Renault, V., Humblet, M. F., & Saegerman, C. (2021). Biosecurity concept: Origins, evolution and perspectives. Animals, 12(1), 63.
Rømo, G., Åkerstedt, J., Nordstoga, A. B., Borge, A. J., Wisløff, H., Gjerset, B., Klevar, S., Valheim, M., Mjømen, I. S., Schei-Berg, E., Vatn, S., & Kampen, A. H. (2024). Investigation, management and control of a maedi outbreak in Norway in 2019–2020. Acta Veterinaria Scandinavica, 66(1), 28.
Schirdewahn, F., Lentz, H. H. K., Colizza, V., Koher, A., Hövel, P., & Vidondo, B. (2021). Early warning of infectious disease outbreaks on cattle-transport networks. PloS One, 16(1), e0244999.
Stevenson, M., & Halpin, K. (2021). Emerging and endemic zoonotic diseases: Surveillance and diagnostics. Revue Scientifique et Technique, 40(1), 119–129.
Sushma, B., Shedole, S., Suresh, K. P., Leena, G., Patil, S. S., & Srikantha, G. (2021). An estimate of global anthrax prevalence in livestock: A meta-analysis. Veterinary World, 14(5), 1263–1271.
Tambo, E., & Al-Nazawi, A. M. (2022). Combating the global spread of poverty-related Monkeypox outbreaks and beyond. Infectious Diseases of Poverty, 11(1), 80.
Torres-Velez, F., Havas, K. A., Spiegel, K., & Brown, C. (2019). Transboundary animal diseases as re-emerging threats – Impact on one health. Seminars in Diagnostic Pathology, 36(3), 193–196.
Uddin, M. A., Islam, M. A., Rahman, A. K. M. A., Rahman, M. M., Khasruzzaman, A. K. M., Ward, M. P., & Hossain, M. T. (2022). Epidemiological investigation of lumpy skin disease outbreaks in Bangladeshi cattle during 2019–2020. Transboundary and Emerging Diseases, 69(6), 3397–3404.
Wainwright, S. H., Cunha, C. W., Webb, B., McGregor, B., Drolet, B., & Welch, J. B. (2024). Reemerging/notifiable diseases to watch. The Veterinary Clinics of North America, Food Animal Practice, 40(2), 317–335.
Yatsenko, I. (2023a). Defekty veterynarnoyi diyal′nosti yak predmet sudovo-veterynarnoho doslidzhennya [Veterinary defects as a subject of forensic veterinary investigation]. Law, Human, Environment, 14(4), 92–108 (in Ukrainian).
Yatsenko, I. (2023b). Doktryna hnoseolohichnoyi konstruktsiyi fenomenu defektu veterynarnoyi dopomohy v sudovo-veterynarniy ekspertyzi [Epistemological construction doctrine of the veterinary care defect phenomenon in forensic veterinary examination]. Law, Human, Environment, 14(3), 115–132 (in Ukrainian).
Yatsenko, I. (2023c). Pravovyy status i hnoseolohichna kharakterystyka obyektiv sudovo-veterynarnoyi ekspertyzy [Legal status and epistemological characteristics of forensic veterinary science objects]. Theory and Practice of Forensics and Criminalistics, 31, 63–102 (in Ukrainian).
Zadorozhna, V. I., Shahinyan, V. R. & Vynnyk, N. P. (2024). Biobezpeka, biozakhyst i “Khvoroba X”: Definitsiyi, hlobal′ni ta natsional′ni problemy, shlyakhy vyrishennya [Biosafety, biosecurity and "Disease X": definitions, global and national problems, solutions]. Infektsiyni Khvoroby, 117, 53–63 (in Ukrainian).
Zucca, P., Rossmann, M. C., Osorio, J. E., Karem, K., De Benedictis, P., Haißl, J., De Franceschi, P., Calligaris, E., Kohlweiß, M., Meddi, G., Gabrutsch, W., Mairitsch, H., Greco, O., Furlani, R., Maggio, M., Tolomei, M., Bremini, A., Fischinger, I., Zambotto, P., Wagner, P., … Zamaro, G. (2020). The "Bio-Crime Model" of cross-border cooperation among veterinary public health, justice, law enforcements, and customs to tackle the illegal animal trade/bio-terrorism and to prevent the spread of zoonotic diseases among human population. Frontiers in Veterinary Science, 7, 593683.