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Strengthening Viral Disease Control After Foot-and-Mouth Disease (FMD) Outbreak and Peste des Petits Ruminants (PPR) Preparedness in Livestock for Veterinary Personnel in Bojonegoro Regency, Indonesia

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Abstract

Foot and Mouth Disease (FMD) and Peste des Petits Ruminants (PPR) are recognized as major transboundary viral diseases and are a threat to small ruminants in Indonesia. The recent outbreak of FMD has caused substantial economic loss for the farmers, especially for smallholder farmers. To strengthen preparedness and veterinary services against viral livestock diseases, we conducted a technical guidance program at Bojonegoro Regency Livestock and Fisheries Office, East Java, Indonesia on May 4-5, 2026. The participants consisted of staff members from the Bojonegoro Regency Livestock and Fisheries Office the Department of Animal Husbandry and Fisheries and veterinary technician who worked in the Bojonegoro area. The methods of the technical guidance were pre-tests, educational presentation and evaluation with post-tests. Participants showed a high level of knowledge and experience prior to the implementation of the technical guidance program. The maximum score was already achieved in the pre-test assessment which means that the users were well trained and experienced in animal health management. People with good knowledge and experience in animal health are important in early detection and reporting, outbreak investigation as well as to implement biosecurity measures and thus in agricultural development and animal health outcomes. This study was related with Sustainable Development Goals (SDGs) 2 (Zero Hunger) and 3 (Good Health and Well-being) for animal health.

Keywords: FMD; Viral; Disease; Livestock; Bojonegoro; Indonesia; Zero Hunger; Good and Health-Being

1. Introduction

Transboundary animal diseases are a major challenge to global livestock production and food security. The most economically important viral diseases are Peste des Petits Ruminants (PPR) and Foot-and-Mouth Disease (FMD). Both are highly contagious and cause large outbreaks of diseases that caused economic losses due to mortality, decreased productivity, trade restrictions, and increased disease control costs [1,2].

To improve preparedness and strengthen veterinary services against viral livestock diseases, a technical guidance program was conducted on May 4–5, 2026 at the Department of Animal Husbandry and Fisheries of Bojonegoro

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Regency, East Java, Indonesia. The activity was organized as part of a community service program by lecturers from the Faculty of Veterinary Medicine, Universitas Airlangga. The participants consisted of staff members from the Department of Animal Husbandry and Fisheries and veterinarians working in the Bojonegoro area. Educational activities were delivered mainly through lecture-based presentation and scientific discussions concerning post-FMD management and early recognition of PPR.

PPR primarily affects small ruminants such as goats and sheep and is characterized by fever, erosive stomatitis, diarrhea, pneumonia, and mortality [3]. The disease has spread extensively across Africa, the Middle East, and Asia, and the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (WOAH) have started a global eradication strategy [4].

FMD is another highly contagious viral disease affecting cloven-hoofed animalssuch as cattle, buffaloes, goats, sheep, and pigs. Clinical manifestations of FMD are fever, vesicular lesions in the mouth and feet, lameness, and reduced milk production [5]. Indonesia experienced a major re-emergence of FMD in 2022 after decades of disease-free status, leading production losses [6].

Although PPR has not been officially detected in Indonesia, the possibility of virus introduction through animal movement and international trade necessitates strengthened surveillance and preparedness measures [7]. Therefore, understanding the epidemiology and control strategies of both diseases are important for veterinary public health and livestock resilience.

2. Literature Review of PPR and FMD

PPR is caused by Peste des Petits Ruminants Virus (PPRV), a single-stranded negative-sense RNA virus belonging to the genus *Morbillivirus* in the family *Paramyxoviridae* [8]. This disease mainly affects goats and sheep and generally showed more severe clinical signs. Morbidity rates are 100%, while mortality ranges from 50–100% depending on host susceptibility and immune status [9].

FMD is caused by Foot-and-Mouth Disease Virus (FMDV), a positive-sense single-stranded RNA virus from the genus *Aphthovirus* and family *Picornaviridae* [10]. FMD affects all cloven-hoofed animals and is characterized by vesicular lesions and erosions in the oral cavity, feet, and teats. Morbidity rates are extremely high, although mortality is usually low in adult animals and higher in young animals due to myocarditis [11].

Both diseases are classified as notifiable transboundary animal diseases by WOAH due to their rapid spread and severe socioeconomic impact [12]. Importantly, neither PPR nor FMD is considered zoonotic diseases.

2.1. Etiology and Pathogenesis

PPRV is an enveloped virus with six structural proteins including nucleoprotein (N), phosphoprotein (P), matrix protein (M), fusion protein (F), hemagglutinin protein (H), and large polymerase protein (L) [13]. Four genetic lineages (I–IV) have been identified, with lineage IV predominantly circulating in Asia [14].

The virus primarily infects epithelial and lymphoid tissues, resulting in severe immunosuppression, leukopenia, and lymphoid depletion [15]. Transmission mainly occurs through aerosol droplets and direct contact with infected secretions such as nasal discharge, saliva, feces, and milk [16].

FMDV is a non-enveloped icosahedral virus with seven serotypes: O, A, C, Asia1, SAT1, SAT2, and SAT3 [17]. Antigenic diversity among serotypes complicates vaccine development and disease control programs. The virus replicates in epithelial tissues, causing vesicle formation and erosive lesions [18].

FMD transmission occurs through direct contact, aerosol spread, contaminated fomites, feed, water, and animal products [19]. The virus can spread over long distances under favorable environmental conditions, especially in humid climates. Recovered animals may become carriers, particularly cattle and buffaloes, harboring the virus in the oropharyngeal region for several months [20].

2.2. Clinical Signs and Pathological Lesions

Clinical manifestations of PPR include high fever, depression, anorexia, mucopurulent nasal discharge, conjunctivitis, necrotic stomatitis, diarrhea, dehydration, and bronchopneumonia [21]. Peracute cases, especially in goats, may result

in sudden death with minimal lesions. Typical pathological findings include erosive stomatitis, necrotic enteritis, pulmonary congestion, enlarged lymph nodes, and characteristic "zebra stripe" lesions in the colon [22].

FMD is characterized by fever, hypersalivation, vesicular lesions in the mouth and feet, lameness, weight loss, and decreased milk production [23]. In severe cases, especially in young animals, myocarditis may occur, producing the characteristic "tiger heart" lesion [24]. Secondary bacterial infections frequently complicate healing of oral and foot lesions.

Both diseases induce immunosuppression, predisposing animals to secondary infections and delayed recovery [25].

2.3. Diagnosis and Sample Collection

Accurate diagnosis is essential for rapid disease control and outbreak prevention. Laboratory diagnosis of PPR and FMD commonly involves virus isolation, conventional RT-PCR, real-time RT-PCR, antigen ELISA, antibody ELISA, and virus neutralization tests [26].

Samples for PPR diagnosis include ocular, nasal, buccal, and rectal swabs, whole blood, serum, lymph nodes, spleen, lung, and intestinal tissues [27]. For FMD diagnosis, vesicular fluid, epithelial tissue, probang samples, serum, and oral swabs are commonly collected [28].

All samples must be transported under strict cold-chain conditions using viral transport media to preserve viral integrity and biosafety standards [29].

2.4. Vaccination and Disease Control Strategies

Vaccination remains the cornerstone for controlling both PPR and FMD. Live attenuated PPR vaccines such as Nigeria 75/1 and Sungri/96 strains provide protective immunity for up to three years [30]. Vaccination is usually recommended for small ruminants aged 4–6 months. FMD vaccines are generally inactivated vaccines containing purified viral antigen. Due to the short duration of immunity and antigenic variation among serotypes, booster vaccinations are required every six months [31].

Comprehensive disease control programs should include:

- Mass vaccination,
- Biosecurity enhancement,
- Movement restriction,
- Quarantine,
- Active surveillance,
- Farmer education,
- Sanitation and disinfection,
- Rapid outbreak reporting [32].

Supportive treatment for FMD cases may include anti-inflammatory drugs, antipyretics, antibiotics for secondary bacterial infections, vitamin supplementation, wound management, and fluid therapy [33].

2.5. Post-FMD Strengthening Approach and PPR Prevention in Indonesia

Indonesia continues to strengthen its FMD control strategy through the Progressive Control Pathway for FMD (PCP-FMD) and national eradication roadmaps targeting FMD-free status by 2035 [34]. Key strategies include sustained vaccination campaigns, improved veterinary services, surveillance systems, and farmer communication programs. Even though PPR has not yet been reported in Indonesia, preventive measures remain critical. These include strengthening animal quarantine systems, surveillance in high-risk areas, laboratory preparedness, and public awareness campaigns [35]. Cross-sector collaboration among veterinary authorities, quarantine agencies, researchers, universities, and livestock producers is essential to enhance preparedness against emerging transboundary animal diseases [36].

3. Material and Method

This program was conducted for two days at the Department of Animal Husbandry and Fisheries of Bojonegoro Regency on May 4–5, 2026. This study uses a descriptive quantitative approach with a sample of 24 respondents. The participants consisted of staff members from the Bojonegoro Regency Livestock and Fisheries Office the Department of

Animal Husbandry and Fisheries and veterinary technician who worked in the Bojonegoro area. The methods of the technical guidance were pre-tests, educational presentation and evaluation with post-tests. Educational activities were delivered mainly through lecture-based presentation and scientific discussions concerning post-FMD management and early recognition of PPR. Knowledge assessment was conducted using a structured questionnaire administered before (pre-test) and after (post-test) the technical guidance program. Descriptive statistical analysis was conducted by comparing participants' total scores, percentage achievements, and mean scores obtained before and after the educational intervention. The impact of the program was assessed by evaluating the magnitude of score gains observed in the post-test relative to the pre-test results.

4. Results and Discussion

4.1. Demographic Characteristics

A total of 24 participants attended the technical guidance program aimed at strengthening the capacity of livestock health personnel in the prevention and management of viral diseases, especially after Foot-and-Mouth Disease (FMD) outbreak and Peste des Petits Ruminants (PPR) preparedness in livestock. The demographic characteristics of respondent were presented in Table 1. The majority of respondents were male (79%), followed by female (21%). This distribution is consistent with the workforce composition commonly observed in livestock and agricultural extension services in many developing countries, where field-based animal health activities are often dominated by male personnel [37]. Based on age distribution, most respondents were classified as middle-aged adults (67%), followed by young adults (29%, n = 7), while only one participant (4%) belonged to the older adult category. The predominance of middle-aged participants indicates that the program successfully engaged experienced personnel who are actively involved in livestock health management and disease control activities. Professional experience has been shown to enhance the ability of extension and animal health officers to adopt and disseminate new knowledge and technologies, thereby improving the effectiveness of disease prevention and control programs [38].

Table 1 Demographic Characteristics of Respondents (n=24)

Characteristics	Category	Frequency (n=24)	Percentage (%)
Sex	Male	19	79%
	Female	5	21%
Age (years)	Young Adults (20-55)	7	29%
	Middle-aged Adults (40-59)	16	67%
	Old Adults (>59)	1	4%
Education	Senior high school	9	38%
	Vocational	2	8%
	University (Bachelor Degree)	13	54%
Occupation	Livestock engineering officer	23	96%
	Veterinary paramedics	1	4%

Regarding educational background, majority of respondents were bachelor's degree (54%). Higher educational levels are generally associated with improved comprehension of technical information, greater problem-solving abilities, and enhanced adoption of evidence-based practices in livestock production and animal health management. Therefore, the educational profile of participants suggests a favorable foundation for understanding and applying the knowledge delivered during the technical guidance program. For occupation, livestock engineering officers represented the majority of respondents (96%), while only one participant (4%) was a veterinary paramedic. This finding highlights the strategic role of livestock officers in implementing field-level disease surveillance, farmer education, biosecurity promotion, and livestock development programs. Effective disease control programs depend heavily on the competencies and preparedness of frontline animal health personnel who interact directly with livestock producers and local communities [39].

4.2. Knowledge Assessment Before and After Technical Guidance

The effectiveness of the technical guidance program was evaluated using a pre-test and post-test questionnaire consisting of 15 statements related to animal health management, disease prevention, medication use, and participants' training needs. The comparison of pre-test and post-test scores is presented in Table 2.

Overall, participants demonstrated a high baseline level of knowledge prior to the implementation of the technical guidance program. For most statements, the maximum score was already achieved during the pre-test assessment, indicating that participants possessed substantial prior knowledge and experience related to animal health management. Consequently, no measurable increase was observed in the majority of indicators following the training, resulting in an N-Gain score of 0%.

Statements related to the recognition of common signs of illness in animals, differentiation of disease severity, initial management of sick animals, environmental hygiene, appropriate medication use, antibiotic resistance, clinical observation, and referral procedures all obtained identical scores in both pre-test and post-test evaluations. These findings suggest that participants, who were predominantly livestock engineering officers with considerable field experience, were already familiar with fundamental concepts of animal health and disease management before participating in the program.

Interestingly, statement 12 ("I need training on the safe and effective use of medication") showed a slight increase from 14 to 15 participants, corresponding to an N-Gain score of 6.25%. This result suggests that the technical guidance program increased participants' awareness of the importance of rational drug use and the need for continuous professional development in veterinary pharmacology. Although participants generally understood the principles of medication administration, the training may have highlighted additional complexities related to drug safety, dosage accuracy, withdrawal periods, and antimicrobial stewardship. Previous studies have emphasized that inappropriate drug use remains a significant challenge in livestock production systems and contributes to the emergence of antimicrobial resistance, which is recognized as a major global public health concern [28].

Table 2 Comparison of pre-test and post-test results

No	Category	Pre-test	Post-test	N-Gain Score (%)
1	I understand the common signs of a sick animal	15	15	0
2	I can differentiate between mild, moderate and emergency conditions in animals.	15	15	0
3	I know the right initial steps to take when encountering a sick animal.	15	15	0
4	I understand the importance of a clean cage/environment in preventing disease.	14	14	0
5	I understand that medication must be used according to the indications and at the correct dosage.	15	15	0
6	I understand that inappropriate antibiotic use can lead to resistance problems.	15	15	0
7	I have encountered cases of animal illnesses such as diarrhea, wounds, infections, skin infections, worms, or respiratory problems.	15	15	0
8	I understand the importance of immediately referring certain cases to a veterinarian or animal health worker.	15	15	0
9	I understand the importance of observing clinical symptoms before administering treatment.	15	15	0
10	I feel that technical training is very helpful in decision-making in the field.	14	14	0
11	I need practical guidance for initial handling of animal cases in the field.	15	15	0
12	I need training on the safe and effective use of medication.	14	15	6,25
13	I need materials on danger signs in animals that require immediate referral.	15	15	0

14	I need simple educational materials in the form of leaflets, posters, or pocket books.	15	15	0
15	I hope there will be further assistance after this activity.	15	15	0

These results indicate that participants perceive technical guidance activities as valuable resources for supporting field decision-making and strengthening animal health services. Despite possessing adequate baseline knowledge, participants continued to express interest in receiving practical tools, updated information, and ongoing mentoring. This finding supports the concept that professional competency development should be viewed as a continuous process rather than a one-time intervention [40].

5. Conclusion

Technical guidance activities conducted at the Department of Animal Husbandry and Fisheries of Bojonegoro Regency on May 4–5, 2026 contributed to strengthening the knowledge and preparedness of veterinary personnel regarding viral livestock diseases. Lecture-based educational approaches provided an effective method for disseminating updated scientific information and practical disease control strategies. This study demonstrate that the technical guidance program successfully reinforced existing knowledge and increased awareness regarding specific aspects of animal health management. Well-trained animal health personnel play a critical role in early detection, reporting, outbreak investigation, and implementation of biosecurity measures, thereby contributing to sustainable livestock development and improved animal health outcomes. Future training programs may benefit from incorporating more advanced learning materials, case-based discussions, simulations, and practical demonstrations tailored to the needs of experienced personnel. Furthermore, evaluation methods that assess changes in attitudes, skills, confidence, and field practices may provide a more comprehensive understanding of training effectiveness than knowledge assessments alone.

Compliance with ethical standards

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Disclosure of Conflict of Interest

The authors declare that there are no conflicts of interest associated with the publication of this study. No financial, institutions, or personal relationships influenced the study design, data management, analysis, interpretation of results, or writing of this article.

Statement of Ethical Approval

This study involved a a technical guidance program to improve preparedness and strengthen veterinary services against viral livestock diseases. This study did not involve biomedical experimentation, invasive procedures, or the use of experimental animals. Activities were limited to training sessions, educational presentation, and knowledge evaluations using pre-test and post-test instruments. As the study was conducted within the framework of community outreach and capacity development activities, formal ethical clearance from an institutional review board was not required in accordance with current regulatory guidelines.

Statement of Informed Consent

Before participation, all respondents provided informed consent after receiving an explanation of the study objectives, procedures, and the voluntary nature of their involvement. Participants were assured that all collected data would be anonymized and used solely for academic and publication purposes. Measures were implemented to ensure confidentiality and safeguard participant privacy throughout the research process.

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