https://doi.org/10.29326/2304-196X-2026-15-1-6-12

Methodological approaches for the prevention and eradication of caprine arthritis-encephalitis in international goat herds: A review

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ABSTRACT

Introduction. Caprine arthritis-encephalitis (CAE) is a chronic viral disease of goats caused by a lentivirus from the *Retroviridae* family (small ruminant lentivirus group, SRLV). Infection typically involves prolonged asymptomatic carriage, progressing to debilitating lesions in the joints, central nervous system, lungs, and mammary gland. Transmission occurs primarily via colostrum, milk, and direct contact, including fomites and co-mingling with infected animals. Diagnosis relies on serological and molecular methods.

Objective. To summarize international methodological approaches for the prevention of CAE.

Materials and methods. This review was conducted based on an analysis of publications in peer-reviewed scientific journals, official international guidelines, and reports from key organizations such as the Food and Agriculture Organization and the World Organisation for Animal Health. Literature was identified and selected through searches in major scientific databases, including Web of Science, Scopus, PubMed, Google Scholar, Science Hub, CyberLeninka and others.

Results. Analysis of the literature indicates that the most effective outcomes in controlling CAE have been achieved in countries with mandatory national eradication programs, which integrate comprehensive preventive, diagnostic, and administrative measures (e.g., Norway, Switzerland). In nations with voluntary participation programs (e.g., Australia, New Zealand, Canada, Italy, France), positive results are also evident, particularly when supported by incentive mechanisms and sustained educational outreach. Conversely, in countries lacking coordinated national programs (e.g., Turkey, Brazil, Iran, and most African nations), disease control remains inadequate, and seroprevalence rates are consistently high.

Conclusion. The most effective outcomes in controlling CAE have been achieved in countries with mandatory national eradication programs, which integrate comprehensive preventive, diagnostic, and administrative measures (e.g., Norway, Switzerland).

Keywords: review, caprine arthritis-encephalitis, prevention, serological monitoring, eradication programs

For citation: Koptev V. Yu., Likhacheva N. O., Shkil N. A., Yurkova I. M. Methodological approaches for the prevention and eradication of caprine arthritis-encephalitis in international goat herds: A review. *Veterinary Science Today*. 2026; 15 (1): 6–12. https://doi.org/10.29326/2304-196X-2026-15-1-6-12

Conflict of interests: The authors declare no conflict of interests.

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УДК 619:616.98:578.833.27:616.72-002:636.39(048)

Методические подходы к профилактике и оздоровлению популяции коз от артрита-энцефалита в зарубежных странах (обзор)

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РЕЗЮМЕ

Введение. Артрит-энцефалит коз – хроническое вирусное заболевание, вызываемое лентивирусами семейства *Retroviridae*, относящимися к группе SRLV (лентивирусы мелкого рогатого скота). Заболевание характеризуется длительным бессимптомным вирусоносительством с последующим прогрессирующим поражением суставов, центральной нервной системы, легких и ткани молочных желез. Вирус может передаваться с молозивом и молоком, при прямом контакте, через оборудование и при совместном содержании здоровых и инфицированных животных. Диагностика заболевания основана на использовании иммунологических и молекулярно-биологических методов.

Цель обзора. Обобщение зарубежных методических подходов к профилактике артрита-энцефалита коз.

Материалы и методы. При написании обзора были использованы публикации в рецензируемых журналах, официальные зарубежные методические рекомендации, а также отчеты Продовольственной и сельскохозяйственной организации Объединенных Наций, Всемирной организации здравоохранения животных. Отбор источников производился в базах данных Web of Science, Scopus, Google Scholar, PubMed, Science Hub, КиберЛенинка и др.

Результаты. Анализ литературных источников показывает, что наиболее эффективные результаты по борьбе с данным заболеванием достигнуты в странах, где разработаны обязательные государственные программы, включающие комплекс профилактических, диагностических и административных мер (Норвегия, Швейцария). В странах с добровольным участием в программах оздоровления (Австралия, Новая Зеландия, Канада, Италия, Франция) при наличии практики стимулирующих механизмов и информационной поддержки также наблюдаются положительные результаты. В странах с отсутствием координированных программ (Турция, Бразилия, Иран, большинство африканских стран) уровень контроля за распространением заболевания остается низким, а серопревалентность – высокой.

Заключение. Наибольших успехов в борьбе с данным заболеванием удалось достичь в странах, где разработаны обязательные государственные программы по контролю и искоренению, включающие комплекс профилактических, диагностических и административных мер (Норвегия, Швейцария).

Ключевые слова: обзор, артрит-энцефалит коз, профилактика, серомониторинг, программы по искоренению заболевания

Для цитирования: Коптев В. Ю., Лихачева Н. О., Шкиль Н. А., Юркова И. М. Методические подходы к профилактике и оздоровлению популяции коз от артрита-энцефалита в зарубежных странах (обзор). *Ветеринария сегодня.* 2026; 15 (1): 6–12. https://doi.org/10.29326/2304-196X-2026-15-1-6-12

Конфликт интересов: Авторы заявляют об отсутствии конфликта интересов.

Для корреспонденции: Коптев Вячеслав Юрьевич, канд. вет. наук, ведущий научный сотрудник, заведующий лабораторией болезней молодняка ИЭВСиДВ СФНЦА РАН, а/я 8, р. п. Краснообск, 630501, Новосибирская обл., Россия, *kastrolog@mail.ru*

INTRODUCTION

Caprine arthritis-encephalitis (CAE) is a persistent viral infection caused by small ruminant lentiviruses (SRLV) within the *Retroviridae* family. SRLVs are classified into five genotypes (A, B, C, D, E) with further subtype divisions [1, 2, 3].

CAE pathogenesis is described in detail in several scientific publications [4, 5, 6] and in dedicated chapters of various monographs [7, 8, 9]. Infection typically involves prolonged asymptomatic carriage, progressing to debilitating lesions in the joints, central nervous system, lungs, and mammary gland.

Several authors [10, 11, 12, 13, 14] confirm that CAEV transmission occurs primarily via colostrum, milk, and direct contact, including fomites and co-mingling with infected animals. Cases of interspecies transmission of the virus between goats and sheep have also been documented [15, 16].

Diagnosis relies on serological methods such as enzyme-linked immunosorbent assay (ELISA) and the agar gel immunodiffusion (AGID), and polymerase chain reaction (PCR) and sequencing [17, 18, 19].

The key risk factors amplifying outbreaks include retaining seropositive animals without segregation or culling; mixing infected and healthy goats in crowded housing; communal use of kidding pens and lack of disease preventive measures.

Serological studies using AGID have documented high CAE virus (CAEV) seroprevalence exceeding 65% in dairy goat populations of several developed countries with advanced goat industries, including Canada, France, Norway, Switzerland, and the United States [20].

The purpose of this review is to summarize international methodological approaches for the prevention of caprine arthritis-encephalitis in search of most effective ways.

EUROPE

Norway. Norway launched the Healthier Goats program as a voluntary initiative in the early 2000s, and it transitioned to mandatory participation in high-prevalence regions from 2012. The integrated strategy involved culling seropositive animals, immediate separation ("snatching") of kids post-birth for rearing on cow colostrum or milk replacers in isolated barns, serological testing and herd certification.

Comprehensive studies confirmed the high effectiveness of the program: circulating CAEV variants were effectively eliminated [21].

Over 15 years of the program, the proportion of CAE-positive dairy goat herds plummeted from 30% to under 1% [22], demonstrating marked improvements in herd health and productivity, with financial viability hinged on state subsidies [23].

Switzerland. This country pioneered a national CAE eradication program. The program started in the early 1980s and official data indicate over 90% of farms attained CAE-free certification by 2008 [24].

The program's target was complete eradication of the infection by rigorous serological testing, culling of seropositive goats, and strict animal movement controls to achieve virus-free status [25].

The control measures were monitored by the Swiss Goat Breeders' Association (SZZV) and federal veterinary authorities [26, 27].

France. France manages CAE through voluntary regional and national programs coordinated by veterinary services, with farmer cooperatives and networks. Since around 2020, voluntary herd certification schemes and farm hygiene certification have gained traction [28].

One of the key initiatives is Plan de qualification sanitaire des élevages caprins, which is a tool for goat farm biosecurity assessment and improvement [29].

Italy (South Tyrol, Northern Italy). Italy implements CAE control through regional programs, particularly in South Tyrol, where veterinary authorities and laboratory networks collaborate on compulsory eradication efforts since late 2000s.

The main approach is identification of positives by serological monitoring for selective removal and culling seropositive animals individually without mass slaughter [30]. This strategy has proved effective: by 2020, most farms in the region achieved CAE-free status [31].

Other Italian regions maintain less uniform, voluntary efforts with variable coverage.

Spain. Spain lacks official recognition of CAE as a notifiable infectious disease under national legislation, resulting in no mandatory control or eradication programs. Prevention relies entirely on voluntary farmer initiatives.

Seroprevalence in dairy goat herds remains elevated at 12–23% [32].

A similar situation can be observed in ***Germany.*** The country maintains around 120,000 goats, representing about 1% of the EU's total goat population [33], with no federal notifiable status or mandatory control program for CAE [34].

NORTH AMERICA

The USA. A 1981 study across 24 states reported a strikingly high CAE seroprevalence of 81% in goat populations [35]. A 1992 study published in the Journal of the American Veterinary Medical Association confirmed widespread CAE infection in U.S. dairy goat herds, particularly in California and northwestern states. Researchers tested 3,790 goats across 28 states using identifying 1,175 seropositive animals – a 31% prevalence rate [36].

The United States lacks a federal mandatory program for CAE despite research since the 1980s.

The programs rely on voluntary initiatives at state, regional, and farm levels informed by scientific studies and international guidelines and are developed in partnership with state veterinary services and universities.

Minnesota exemplifies U.S. state-level voluntary CAE control, where since 2006 farmers have participated in testing and registration to maintain negative herd status [37]. Iowa supports voluntary CAE control through regular training seminars educating goat owners in serological monitoring, culling or segregating seropositive goats, artificial rearing of newborns with heat-treated colostrum or replacers [38]. In the state of Michigan, owners of seropositive animals are recommended to carry out "sterile lambing" (immediate kid-dam separation at birth to prevent colostrum/milk exposure), regular serological testing and culling of positives, and establishment/maintenance of CAE-negative herds [39].

A number of universities, in particular Washington State University, Iowa State University, Michigan State University, Alabama Agricultural and Mechanical University, provide consultations, manuals, and training on CAE eradication for goat farms [40, 41].

Standard protocols for goat herd owners include the following:

– serological screening starting at 6 months of age;

– segregation of seropositive and seronegative animals followed by culling infected ones;

– "sterile lambing" via immediate post-birth kid separation with pasteurized colostrum/milk or replacers;

– rigorous disinfection of equipment and facilities;

– and quarantine/testing bans on new imports.

The United States Department of Agriculture (USDA) and its Animal and Plant Health Inspection Service (APHIS) collaborate with state veterinary services on animal health surveillance, providing diagnostic support and research for CAE, but maintain no centralized mandatory control or eradication program. In the United States, goat owners have widespread access to CAE diagnostic testing through state and university veterinary labs, backed by scientific guidance, financial grants and coordination with state services for lab cooperation [42, 43].

The American Dairy Goat Association (ADGA) does not run a standalone CAE control program but promotes established veterinary protocols and measures to control and to curb spread in dairy herds.

Canada. Canada lacks a unified federal CAE control program, relying instead on effective provincial initiatives and industry-led efforts through associations like the Ontario Goat Association [44]. The Ontario Goat Association's GoGen Dairy Genetic Improvement Program offers detailed guidance:

– whole-herd diagnostics with kids tested at 4–6 months, 8–10 months, and post-12 months pre-kidding, plus semi-annual post-partum checks [44];

– "sterile lambing" via immediate weaning, separate rearing on pasteurized colostrum/milk or replacers;

– isolation/culling of seropositives;

– sourcing CAE-free breeders;

– quarantining new arrivals until testing clears them;

– "low-risk" farm certification.

SOUTH AMERICA

South American countries report elevated CAE seroprevalence. Regular PCR and serological investigations map strains and risk factors, but no national eradication initiatives exist [45, 46, 47].

Brazil. Brazil's 2019 epizootological surveys reported CAE seroprevalence ranging from 2–17% nationally, with different rates among regions and farms. The peaks above 10% were reported in Alagoas, Ceará and São Paulo regions, versus lower rates in Maranhão and Paraíba [45].

Brazil lacks a centralized national CAE eradication program, but there are a number of mandatory measures and initiatives implemented at the regional and federal levels, including mandatory confirmation and reporting. The Ministry of Agriculture and Livestock (MAPA) mandates case confirmation, reporting, and surveillance registration to track spread, integrating CAE into veterinary monitoring. The Brazilian Agricultural Research Corporation (Embrapa) has produced technical manuals detailing symptoms, diagnostics (ELISA, PCR), prevention (testing, quarantine), breeding practices, annual screening, and farm-specific control plans tailored to technological capacity [45].

Some states apply partial on-farm eradication via selective measures.

Argentina. Argentina reported a 3.86% seroprevalence of CAEV in goat herds in a 2011 nationwide study [46].

The National Food Safety and Quality Service (SENASA) oversees voluntary CAE control, which includes the following:

– epizootological control: mandatory farm registration, case notifications, and epizootological investigations upon positives;

– diagnostics and monitoring: ELISA/AGID serological diagnostics with routine surveys for CAEV antibodies in accredited SENASA laboratories;

– spread prevention: seropositive isolation/culling, movement controls requiring CAE-negative certification, bans on raw infected milk for kids, "clean herd" formation via testing/selection;

– eradication measures: gradual eradication through status segregation and seronegative breeding;

– educational work: farmer education on biosecurity, veterinary surveillance over program implementation, public awareness campaigns concerning CAE risks and control measures [47].

ASIA AND MIDDLE EAST

Studies by several authors confirm CAE presence across Asia and the Middle East, with seropositive goats in Turkey, Iran, Iraq, Saudi Arabia, Jordan, and Lebanon. The research

highlights genetic diversity in circulating CAEV strains. Preventive measures remain minimal [48, 49, 50].

Turkey. Turkey lacks a nationwide mandatory program for CAE. Monitoring and control are carried out at the local level, mainly in accredited public and private veterinary organizations and laboratories.

A study of 808 goats across three public and seven private farms detected CAEV antibodies in 1.9% (16/808) of samples, predominantly on state farms [51]. Siirt province showed 0% seropositivity suggesting low-prevalence [52]. While Hatay region's two of six provinces had 1.03% via AGID and competitive ELISA [53]. These results findings align with prior reports from Turkey.

Although there is no nationwide program in the country, measures that have proved effective in other countries are applied in practice:

– routine diagnostic testing of animals;
– restricting contact with seropositives;
– mandatory veterinary inspections with serology for all domestic or imported goats before herd integration.

Iran. Iran first detected CAEV via PCR in 2014, with 15.7% prevalence among 95 tested goats [49]. No centralized or government-led CAE eradication programs exist in Iran. Preventive measures are aimed at monitoring and research.

Iraq. Researchers from Al-Qasim Green University first reported CAEV in Iraq in 2022 through PCR analysis of 85 goat blood samples yielding 5.9% (5/85) positives [50]. At the moment, there is no data in open sources on special government programs for CAE control or eradication.

Saudi Arabia. Saudi Arabia maintains no official government programs for CAE eradication. A 1990 serological study on indigenous sheep detected CAEV antibodies only in 0.8% of samples [54].

Jordan. Jordan conducted a 2006 serological survey examining 1,100 goats from 69 herds, revealing 23.2% herd-level seropositivity and 8.9% individual animal prevalence [55]. It should be noted that no national government eradication program exists in Jordan.

Lebanon. Lebanon has no confirmed national government program for CAE eradication, with control limited to research and voluntary farm practices. A 2015 serological study found 13.1% individual seropositivity and 51.7% herd-level infection. Local Baladi breed exhibited greater resistance to the infection [56].

Ongoing Asian studies identify SRLV genetic clusters via sequencing.

China. A 2024 study in eastern China documented approximately 0.8% seropositivity among tested goats [57].

China lacks a dedicated national program exclusively targeting CAE eradication. However, the disease falls under mandatory registration and surveillance as a notifiable condition. The main CAE control measures are the following:

– comprehensive ELISA screening (with confirmatory PCR if needed);
– isolation of animals pending negative status;
– culling seropositives;
– segregation by status;
– rearing kids on pasteurized colostrum/milk from seronegative dams or substitutes.

Japan. From 2002–2004, testing of 3,102 goats showed nearly 20% seropositivity. A 2006–2007 survey of 857 animals from 113 herds across 28 prefectures found 15% herd-level infection and 10% individual seroprevalence [58].

Japan lacks a national CAE eradication program, with control decentralized across regions supported by research institutes like the National Institute of Animal Health (NIAH). NIAH conducts scientifically validated diagnostics (AGID, ELISA, PCR) at a national level, offering recommendations in collaboration with prefectural veterinary services to aid farmers.

India. India reported 3.33% CAE seroprevalence in 2015 studies, with 12 of 360 tested goats seropositive, and clinical cases noted in affected regions [59].

No national CAE control program exists in India. Monitoring occurs via regional veterinary initiatives, which include the following activities: screening via AGID, ELISA, and PCR diagnostics; isolation of seropositives; pasteurization of milk for kids; and equipment hygiene to curb horizontal/vertical spread.

AFRICA

CAEV circulates across multiple African countries, confirmed through serological and molecular evidence, yet systematic monitoring and diagnostic infrastructure remain inadequate.

Algeria. A 2013–2015 serological study in Algeria using ELISA detected CAEV antibodies in 29.7% of tested goats [60].

Sudan. A 2009–2010 serological survey using ELISA across five Sudanese states detected CAEV antibodies in 5.8% of examined goats [61].

Ethiopia. A 2013–2019 serological study in multiple districts of Ethiopia's Amhara State using ELISA identified 4.7% seropositivity for CAEV among tested goats [62].

Our analysis of available data indicates that no country on the continent has implemented a national program for the eradication of CAE. Furthermore, widespread practices such as mass screening of goats, systematic milk pasteurization, animal isolation, or compensation for culling are not established.

OCEANIA

Australia. CAE was first detected in Australia during the 1980s. A 1995 survey across 14 New South Wales dairy farms revealed 56.8% seropositivity [63]. Current data indicate significant declines over 30 years through voluntary controls, though precise figures remain sparse. In 2021, AgriFutures Australia funded a report "Development of innovative tools for the detection and control of caprine arthritis encephalitis virus" for developing affordable serological and molecular diagnostics to enhance on-farm detection and management [64].

In 2022 Animal Health Australia (AHA), in collaboration with the Australian Veterinary Association (AVA) launched the GoatMAP (Market Assurance Program for Goats), a voluntary national scheme to monitor, manage, and minimize CAE and Johne's disease spread in goat herds [65].

A National Kid Rearing Plan was developed. Based on the plan the following measures are used to prevent and eradicate CAE in Australia.

1. Animal identification: individual animal identification with movement tracking.
2. Mandatory health certificates retained for 7 years.
3. Regular (biannual) veterinary inspections for enrolled farms.
4. Kid hygiene: immediate post-kidding isolation of kids fed pasteurized colostrum/milk from seronegative dams to curb horizontal transmission.

5. Segregation: strict seronegative-seropositive segregation.

6. Testing: regular ELISA screening (CAE-free status requires two negatives 6 months apart in goats > 6 months).

7. Culling: culling of clinically affected seropositives [66].

New Zealand. New Zealand first detected CAEV in the early 1980s. The Ministry for Primary Industries (MPI) describes current prevalence as low despite steady presence in goat populations. Currently, the CAE is under control due to strict export and breeding farm requirements, while enforcing an integrated approach [67].

New Zealand Dairy Goat Breeders Association (NZDGBA) accreditation is aimed for certified CAE-free herds. It requires annual ELISA testing of all goats > 1 year for three years. Then testing is performed every three years upon three consecutive negatives. The goal is to gradually establish certified CAE-free herds in New Zealand [68].

Key measures include immediate post-birth kid weaning with pasteurized colostrum/milk from CAE-negative goats or replacers; seronegative-seropositive segregation; dedicated equipment for negatives milked first; pre-entry testing/quarantine for new animals; closed herd policies; and culling seropositives on commercial farms [69].

CONCLUSION

An analysis of literature sources indicates that caprine arthritis-encephalitis is widespread throughout the world. In the fight against this disease, the most effective results have been achieved in countries where mandatory government programs have been developed. These programs typically include a comprehensive set of preventive, diagnostic, and administrative measures. The national programs of Norway and Switzerland serve as exemplary models of this approach. Their success can be attributed to the following key factors:

– mandatory participation of all goat owners;
– centralized control and coordination at the national level;
– mandatory culling of seropositive animals;
– isolation of young stock and feeding of pasteurized milk;
– regular serological monitoring and accurate farm status recording.

In countries with voluntary participation in eradication programs, such as Australia, New Zealand, Canada, and specific regions of Italy and France, positive results have also been observed. These outcomes are particularly evident where well-designed incentive structures and educational support for animal owners are in place.

In countries lacking coordinated government programs, such as Turkey, Brazil, Iran, and most African nations, control over disease spread remains limited, while seroprevalence levels stay persistently high.

REFERENCES

1. Kolbasova O. L., Bespalova T. Yu., Korogodina E. V., Krasnova E. A. Caprine arthritis-encephalitis: early diagnostics topical issues. *Veterinariya Kubani*. 2023; (2): 23–25. https://elibrary.ru/fbcemv (in Russ.)

2. Gjerset B., Storset A. K., Rimstad E. Genetic diversity of small-ruminant lentiviruses: Characterization of Norwegian isolates of caprine arthritis encephalitis virus. *Journal of General Virology*. 2006; 87 (3): 573–580. https://doi.org/10.1099/vir.0.81201-0

3. Zanoni R. G. Phylogenetic analysis of small ruminant lentiviruses. *Journal of General Virology*. 1998; 79 (8): 1951–1961. https://doi.org/10.1099/0022-1317-79-8-1951

4. Smith M. C., Sherman D. M. Goat Medicine. 3rd ed. Ames: Wiley-Blackwell; 2023. 976 p. https://doi.org/10.1002/9781119382775

5. Sheep and Goat Medicine. Ed. by D. G. Pugh, A. N. Baird. 2nd ed. St. Louis: Saunders; 2012. 640 p. https://doi.org/10.1016/C2009-0-60474-8

6. Matthews J. G. Diseases of the Goat. 4th ed. Chichester: Wiley-Blackwell; 2016. 432 p. https://doi.org/10.1002/9781119073543

7. Minguijón E., Reina R., Pérez M., Polledo L., Villoria M., Ramírez H., et al. Small ruminant lentivirus infections and diseases. *Veterinary Microbiology*. 2015; 181 (1–2): 75–89. https://doi.org/10.1016/j.vetmic.2015.08.00

8. Murphy F. A., Gibbs E. P. J., Horzinek M. C., Studdert M. J. Veterinary Virology. 3rd ed. Academic Press; 1999. 629 p.

9. Harwood D. Veterinary Guide to Goat Health and Welfare. Crowood Press; 2019. 224 p.

10. Peterhans E., Greenland T., Badiola J., Harkiss G., Bertoni G., Amorena B., et al. Routes of transmission and consequences of small ruminant lentiviruses (SRLVs) infection and eradication schemes. *Veterinary Research*. 2004; 35 (3): 257–274. https://doi.org/10.1051/vetres:2004014

11. Narayan O., Clements J. E. Biology and pathogenesis of lentiviruses. *Journal of General Virology*. 1989; 70 (7): 1617–1639. https://doi.org/10.1099/0022-1317-70-7-1617

12. Blacklaws B. A., Berriatua E., Torsteinsdottir S., Watt N. J., de Andres D., Klein D., Harkiss G. D. Transmission of small ruminant lentiviruses. *Veterinary Microbiology*. 2004; 101 (3): 199–208. https://doi.org/10.1016/j.vetmic.2004.04.006

13. Kaba J., Czopowicz M., Ganter M., Nowicki M., Witkowski L., Nowicka D., Szaluś-Jordanow O. Risk factors associated with seropositivity to small ruminant lentiviruses in goat herds. *Research in Veterinary Science*. 2013; 94 (2): 225–227. https://doi.org/10.1016/j.rvsc.2012.09.018

14. Brülisauer F., Vogt H.-R., Perler L., Rüfenacht J. Risk factors for the infection of Swiss goat herds with small ruminant lentivirus: a case-control study. *Veterinary Record*. 2005; 157 (8): 229–233. https://doi.org/10.1136/vr.157.8.229

15. Shah C., Huder J. B., Böni J., Schönmann M., Mühlherr J., Lutz H., Schüpbach J. Direct evidence for natural transmission of small-ruminant lentiviruses of subtype A4 from goats to sheep and vice versa. *Journal of Virology*. 2004; 78 (14): 7518–7522. https://doi.org/10.1128/JVI.78.14.7518-7522.2004

16. Pisoni G., Bertoni G., Puricelli M., Maccalli M., Moroni P. Demonstration of coinfection with and recombination by caprine arthritis-encephalitis virus and maedi-visna virus in naturally infected goats. *Journal of Virology*. 2007; 81 (10): 4948–4955. https://doi.org/10.1128/jvi.00126-07

17. Mordasini F., Vogt H.-R., Zahno M. L., Maeschli A., Nenci C., Zanoni R., et al. Analysis of the antibody response to an immunodominant epitope of the envelope glycoprotein of a lentivirus and its diagnostic potential. *Journal of Clinical Microbiology*. 2006; 44 (3): 981–991. https://doi.org/10.1128/JCM.44.3.981-991.2006

18. Cardinaux L., Zahno M.-L., Deubelbeiss M., Zanoni R., Vogt H.-R., Bertoni G. Virological and phylogenetic characterization of attenuated small ruminant lentivirus isolates eluding efficient serological detection. *Veterinary Microbiology*. 2013; 162 (2–4): 572–581. https://doi.org/10.1016/j.vetmic.2012.11.017

19. Ramírez H., Reina R., Amorena B., de Andrés D., Martínez H. A. Small ruminant lentiviruses: genetic variability, tropism and diagnosis. *Viruses*. 2013; 5 (4): 1175–1207. https://doi.org/10.3390/v5041175

20. Adams D. S., Oliver R. E., Ameghino E., DeMartini J. C., Verwoerd D. W., Houwers D. J., et al. Global survey of serological evidence of caprine arthritis-encephalitis virus infection. *Veterinary Record*. 1984; 115 (19): 493–495. https://doi.org/10.1136/vr.115.19.493

21. Norwegian Veterinary Institute. The surveillance programme for small ruminant lentivirus infections in sheep and goats in Norway 2018–2022. Oslo: VetInst; 2023. https://www.vetinst.no/overvaking/maedi-cae-sau-geit

22. Norwegian University of Life Sciences. Healthier Goats disease eradication programme: final report 2001–2015. Ås: Health Services for Goat; 2015. https://nmbu.brage.unit.no/xmlui/handle/11250/2496982

23. Nagel-Alne G. E., Asheim L. J., Hardaker J. B., Sølverød L., Lindheim D., Valle P. S. The Norwegian Healthier Goats programme – a financial cost-benefit analysis. *Preventive Veterinary Medicine*. 2014; 114 (2): 96–105. https://doi.org/10.1016/j.prevetmed.2014.02.002

24. Küker S. Die Ausrottung der Caprinen Arthritis-Enzephalitis in der Schweiz: Ein Paradebeispiel für erfolgreiche Tierseuchenbekämpfung. Bern: Bundesamt für Lebensmittelsicherheit und Veterinärwesen (BLV); 2019. 10 p. https://www.blv.admin.ch/blv/de/home/tiere/tierseuchen/uebersicht-seuchen/alle-tierseuchen/cae.html (in German)

25. Thomann B., Falzon L. C., Bertoni G., Vogt H. R., Schüpbach-Regula G., Magouras I. A census to determine the prevalence and risk factors for caprine arthritis-encephalitis virus and visna/maedi virus in the Swiss goat population. *Preventive Veterinary Medicine*. 2017; 137 (Pt. A): 52–58. https://doi.org/10.1016/j.prevetmed.2016.12.012

26. Schweizerischen Ziegenzuchtverband (SZZV). Tierseuchenverordnung – CAE bei Ziegen. 2018. https://www.kleinwiederkäuer.ch/de/kleinwiederkaeuer/ziegen.html (in German)

27. Bundesamt für Lebensmittelsicherheit und Veterinärwesen. Swiss Animal Health Strategy 2022+. https://www.blv.admin.ch/blv/de/home/das-blv/strategien/tiergesundheitsstrategie-schweiz.html (in German)

28. GDS France. Recommandations pour la maîtrise du CAEV et l'assainissement des troupeaux. GDS BFC; 2023. https://www.gdsbfc.org/assets/files/CAEV_guide_maitrise%20et%20assainissement_GDS%20France%2001_06_23.pdf (in French)

29. Santé Chèvres. Plan de qualification sanitaire des élevages caprins. 2022. https://sante-chevres.fr/IMG/pdf/2022.06.09.cscgo-plan_de_qualification_sanitaire_des_elevages_caprins.pdf (in French)

30. Tavella A., Bettini A., Ceol M., Zambotto P., Stifter E., Kusstatscher N., et al. Achievements of an eradication programme against caprine arthritis encephalitis virus in South Tyrol, Italy. *Veterinary Record*. 2018; 182 (2):51. https://doi.org/10.1136/vr.104503

31. Nardelli S., Bettini A., Capello K., Bertoni G., Tavella A. Eradication of caprine arthritis encephalitis virus in the goat population of South Tyrol, Italy: analysis of the tailing phenomenon during the 2016–2017 campaign. *Journal of Veterinary Diagnostic Investigation*. 2020; 32 (4): 589–593. https://doi.org/10.1177/1040638720934055

32. Contreras A., Corrales J. C., Sánchez A., Adúriz J. J., González L., Marco J. Caprine arthritis-encephalitis in an indigenous Spanish breed of dairy goat. *Veterinary Record*. 1998; 142 (6): 140–142. https://doi.org/10.1136/vr.142.6.140

33. Eurostat. Livestock population in numbers. May 17, 2022. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220517-2

34. Moog U., Einax E., König P. Grundlagen der Bekämpfung von Maedi/Visna und CAE sowie Problemfälle aus der serologischen Diagnostik. *Krankheiten kleiner Wiederkäuer*. 2021; 13–20. https:// www.openagrar.de/servlets/MCRFileNodeServlet/openagrar_derivate_00044301/SD202177253.pdf (in German)

35. Crawford T. B., Adams D. S. Caprine arthritis-encephalitis: clinical features and presence of antibody in selected goat populations. *Journal of the American Veterinary Medical Association*. 1981; 178 (7): 713–719. https://pubmed.ncbi.nlm.nih.gov/6259112

36. Cutlip R. C., Lehmkuhl H. D., Sacks J. M., Weaver A. L. Prevalence of antibody to caprine arthritis-encephalitis virus in goats in the United States. *Journal of the American Veterinary Medical Association*. 1992; 200 (6): 802–805. https://pubmed.ncbi.nlm.nih.gov/1314795

37. The Minnesota Project: OPP Eradication Trial, Fall 2013 – Fall 2017. https://www.bah.state.mn.us/sites/default/files/documents/opp-eradication-trial.pdf

38. Iowa State University Extension and Outreach. Dairy Goats. https://www.extension.iastate.edu/4h/dairy-goats

39. Metzger M. Michigan State University. Caprine arthritic encephalitis virus in goats. October 31, 2018. https://www.canr.msu.edu/news/caprine-arthritic-encephalitis-virus-in-goats

40. Passler T., Bayne J., Brady B. Biosecurity & Disease Prevention in Dairy Goats. Alabama A&M and Auburn Universities. December 7, 2018. https://www.aces.edu/blog/topics/farming/biosecurity-disease-prevention-in-dairy-goats

41. Washington Animal Disease Diagnostic Laboratory (Washington State University). CAE (Caprine Arthritis Encephalitis). https://waddl.vetmed.wsu.edu/2023/02/07/cae-caprine-arthritis-encephalitis

42. United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS). Sheep and Goat Disease. https://www.aphis.usda.gov/livestock-poultry-disease/sheep-goat

43. Minnesota Board of Animal Health. Healthy Sheep and Goats. Ovine Progressive Pneumonia (OPP) – Caprine Arthritis Encephalitis (CAE). https://www.bah.state.mn.us/sites/default/files/documents/OPP-Program-Guidelines.pdf

44. Ontario Goat. Caprine Arthritis Encephalitis Part Two: Preventing and Controlling CAE. https://ontariogoat.ca/goat-gazette/caprine-arthritis-encephalitis-part-two-preventing-and-controlling-cae

45. Embrapa Caprinos e Ovinos. Artrite Encefalite Caprina (CAE). https://www.embrapa.br/cim-inteligencia-e-mercado-de-caprinos-e-ovinos/zoossanitario-cae (in Portuguese)

46. Panei C. J., Gos M. L., Valera A. R., Galosi C. M., Echeverria M. G. First isolation and nucleotide comparison of the *gag* gene of the caprine arthritis encephalitis virus circulating in naturally infected goats from Argentina. *Open Veterinary Journal*. 2017; 7 (1): 32–35. https://doi.org/10.4314/ovj.v7i1.5

47. Trezeguet M. A., Debenedetti R. T., Suarez M. F., Barral L. E., Ramos M. Detección de la artritis-encefalitis caprina, en majadas generales, en Argentina. https://www.produccion-animal.com.ar/sanidad_intoxicaciones_metabolicos/enfermedades_caprinos/41-Artritis.pdf (in Spanish)

48. Hamzah K. J., Mosa A. H. Clinical and serological diagnosis of caprine arthritis encephalitis virus (CAEV) in goats of middle Iraq regions. *Life Science Archives*. 2020; 6 (1): 1771–1777. https://jpsscientificpublications.com/jpsadmin/uploads/attachments/dac239b961d9c0677e79e13a5fb999cb.pdf

49. Kojouri G. A., Emami M., Momtaz H. The first molecular detection of caprine arthritis encephalitis virus (CAEV) in Iran. *Journal of Veterinary Science & Technology*. 2014; 5 (3):1000184. https://www.hilarispublisher.com/open-access/the-first-molecular-detection-of-caprine-arthritis-encephalitis-virus-caev-in-iran-2157-7579.1000184.pdf

50. Mosa A. H., Hamzah K. J., Aljabory H. A. H. First study on the molecular prevalence of caprine arthritis encephalitis virus in goats in Babylon, Iraq. *Veterinary World*. 2022; 15 (4): 1129–1133. https://doi.org/10.14202/vetworld.2022.1129-1133

51. Burgu I., Akça Y., Alkan F., Ozkul A., Karaoğlu T., Cabalar M. Antibody prevalence of caprine arthritis encephalitis virus (CAEV) in goats in Turkey. *Deutsche Tierärztliche Wochenschrift*. 1994; 101 (10): 390–391. https://pubmed.ncbi.nlm.nih.gov/7851298

52. Çelik Ö. Y., Akgül G., İrak K. Investigation of seroprevalence of maedi-visna and caprine arthritis encephalitis in sheep and goats in Siirt province. *Atatürk Üniversitesi Veteriner Bilimleri Dergisi*. 2018; 13 (3): 274–277. https://doi.org/10.17094/ataunivbd.348533

53. Aslantaş Ö., Özyörük F., Pınar D., Güngör B. Serological survey for caprine arthritis-encephalitis virus in Damascus and Kilis goats in Hatay, Turkey. *Revue de Medecine Veterinaire*. 2005; 156 (7): 402–404. http://hdl.handle.net/11452/24276

54. Alluwaimi A. M., Abu Elzein E. M., Hassanein M. M. Caprine arthritis-encephalitis antibodies in indigenous sheep in Saudi Arabia. *Revue d'élevage et de Médecine Vétérinaire des Pays Tropicaux*. 1990; 43 (4): 444–445. https://pubmed.ncbi.nlm.nih.gov/1966759

55. Al-Qudah K., Al-Majali A. M., Ismail Z. B. Epidemiological studies on caprine arthritis-encephalitis virus infection in Jordan. *Small Ruminant Research*. 2006; 66 (1–3): 181–186. https://doi.org/10.1016/j.smallrumres.2005.09.020

56. Tabet E., Hosri C., Abi-Rizk A. Caprine arthritis encephalitis virus: prevalence and risk factors in Lebanon. *Revue Scientifique et Technique*. 2015; 34 (3): 915–921. https://pubmed.ncbi.nlm.nih.gov/27044161

57. Tian Y., Zhang H., Zhang Y., Zhang X., Guan Z., Zhang J., et al. Detection and phylogenetic analysis of caprine arthritis

encephalitis virus using TaqMan-based qPCR in Eastern China. *Veterinary Sciences*. 2024; 11 (3):138. https://doi.org/10.3390/vetsci11030138

58. Konishi M., Hayama Y., Shirafuji H., Kameyama K., Murakami K., Tsutsui T., Akashi H. Serological survey of caprine arthritis-encephalitis virus infection in Japan. *The Journal of Veterinary Medical Science*. 2016; 78 (3): 447–450. https://doi.org/10.1292/jvms.15-0357

59. Waseem A., Pawaiya R. V. S., Singh R., Gupta V. K., Rajukumar K., Mir M. S., Aamir S. Seroprevalence of caprine arthritis encephalitis virus infection (CAEV) in Indian goats. *Indian Journal of Veterinary Pathology*. 2015; 39 (1): 15–19. https://doi.org/10.5958/0973-970X.2015.00004.8

60. Idres T., Lamara A., Temim S., Boudjellaba S., Gagnon J., Chebloune Y. Serological diagnosis of lentivirus infection in goats raised in Algeria. *Journal of Veterinary Research*. 2019; 63 (1): 27–33. https://doi.org/10.2478/jvetres-2019-0001

61. Elfahal A. M., Hussien M. O., Enan Kh. A., Taha Kh. M., Salih D. A., Halfawi R. H. Investigation of caprine arthritis-encephalitis virus in Sudan using competitive enzyme-linked immunosorbent assay. *Veterinary World*. 2013; 6 (8): 558–562. https://doi.org/10.5455/vetworld.2013.558-562

62. Alamerew E. A., Demis C., Asfaw T., Gemeda B. A., Asres F. A., Yitagesu E., et al. Serological evidence of caprine arthritis encephalitis in North Shewa Zone, Ethiopia: clinical case analysis. *Veterinary Medicine: Research and Reports*. 2022; 13: 287–297. https://doi.org/10.2147/vmrr.s378605

63. Greenwood P. L., North R. N., Kirkland P. D. Prevalence, spread and control of caprine arthritis-encephalitis virus in dairy goat herds in New South Wales. *Australian Veterinary Journal*. 1995; 72 (9): 341–345. https://doi.org/10.1111/j.1751-0813.1995.tb07538.x

64. Finlaison D. S., Kirkland P. D. Development of innovative tools for the detection and control of caprine arthritis encephalitis virus. AgriFutures Australia; 2021. https://agrifutures.com.au/wp-content/uploads/2021/07/21-083.pdf

65. Animal Health Australia. GoatMAP: CAEMAP (Caprine Arthritis Encephalitis). Version 1.2. August 2024. https://animalhealthaustralia.com.au/wp-content/uploads/dlm_uploads/2024/08/GoatMAP_CAEMAP_August2024.pdf

66. Animal Health Australia; Goat Industry Council of Australia. National Kid Rearing Plan. 2016. https://www.farmbiosecurity.com.au/wp-content/uploads/2019/04/National-Kid-Rearing-Plan-2016.pdf

67. Ministry for Primary Industries. Import Risk Analysis. Imported Seropositive Animals: Assurance provided by serological tests. 1999. https://www.mpi.govt.nz/dmsdocument/2848-Imported-seropositive-animals-Assurance-provided-by-serological-tests-Import-risk-analysis-July-1999-

68. New Zealand Dairy Goat Breeders Association. Policies and procedures. https://www.nzdgba.co.nz/policies-procedures

69. Morrinsville Veterinary Clinic. CAE: Caprine Arthritis Encephalitis Virus. 2023. https://www.vetclinicmorrinsville.co.nz/blog/post/109785/caprine-arthritis-encephalitis-virus-cae

Received 17.09.2025
Revised 28.11.2025
Accepted 26.01.2026

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