Epidemiology and Surveillance of Rabies in Animals in Sa Kaeo Province, Thailand, 2016–2025

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Summary

Rabies remains an important zoonotic disease and public health concern in Thailand, particularly in areas with persistent animal reservoirs and cross-border movement [1–3]. This study aimed to describe the epidemiological characteristics of rabies in animals and evaluate the performance of the surveillance system in Sa Kaeo Province during 2016–2025. A cross-sectional analysis of 757 submitted samples identified 70 positive cases (9.25%), with dogs accounting for the majority (88.57%). Samples submitted through clinical surveillance showed substantially higher positivity rates than those submitted for rabies-free area certification. Multivariate analysis demonstrated that clinical surveillance submission (adjusted OR = 57.32; 95% CI: 23.46–173), owned animal status (adjusted OR = 6.94; 95% CI: 4.04–11.86), and residence in border districts (adjusted OR = 2.24; 95% CI: 1.06–4.81) were significantly associated with rabies detection. These findings highlight the critical role of the surveillance system in identifying cases and high-risk areas, while also reflecting the limitations of passive, symptom-based surveillance systems [4–7].

Methods

Study Design and Data Source

A cross-sectional study was conducted using data from the national rabies surveillance database (thairabies.net) between 2016 and 2025. The dataset included information on sample submissions, diagnostic results, animal species, ownership status, vaccination history, geographic location, and purpose of submission.

Rabies Surveillance System

Rabies surveillance in Sa Kaeo Province, a border province adjacent to Cambodia, is conducted under the national animal rabies surveillance program coordinated by the Department of Livestock Development (DLD), Thailand. The system primarily relies on passive, symptom-based surveillance, supplemented by targeted sample submissions for rabies-free area certification and outbreak investigations.

Suspected rabies cases are identified by field veterinarians, livestock officers, or local authorities based on clinical signs, history of animal bites, or abnormal behavior. Carcasses or brain samples from suspected animals are submitted to designated regional laboratories for diagnostic confirmation. Laboratory results are recorded in the national surveillance database.

The surveillance system includes two main categories of sample submission: (1) clinical surveillance from animals showing signs compatible with rabies, and (2) surveillance for rabies-free area certification. Epidemiological information is collected for each sample to monitor trends and identify high-risk areas.

Data Analysis

Descriptive statistics were used to summarize epidemiological characteristics. Risk factors associated with rabies detection were assessed using univariate and multivariate logistic regression analyses. Spatial distribution was analyzed using R software.

Results

Between 2016 and 2025, a total of 757 animal samples were submitted for rabies diagnosis in Sa Kaeo Province, of which 70 tested positive, resulting in an overall positivity rate of 9.25%. Among the positive samples, dogs accounted for most cases (62/70; 88.57%). By species, dogs had the highest number of submitted samples (374 samples), with a positivity rate of 16.58%. Cattle and foxes showed high positivity proportions (80% and 100%, respectively), although the number of samples in these groups was limited. No positive cases were detected among cats or other species. Regarding the purpose of sample submission, samples submitted for clinical surveillance showed a substantially higher positivity rate than those submitted for rabies-free area certification (41.14% vs. 0.83%). When classified by ownership status, owned animals had a higher positivity rate than stray or unknown-status animals (30.93% vs. 6.06%). Animals with a recorded vaccination history had a positivity rate of 18.60%, whereas those without or with unknown vaccination history had a positivity rate of 8.68%. Seasonal analysis showed similar positivity rates across summer, rainy, and winter seasons, with no substantial differences observed. However, animals in border districts had a higher positivity rate than those in non-border districts (14.33% vs. 5.78%). Temporal and spatial analyses indicated that rabies cases were detected throughout the study period, with clustering observed in certain districts, particularly along the international border. In univariate logistic regression analysis, factors significantly associated with rabies detection included clinical surveillance submission (OR = 83.03, 95% CI: 35.83–241.95), owned animal status

(OR = 6.94, 95% CI: 4.04–11.86), vaccination history (OR = 2.40, 95% CI: 1.01–5.17), and residence in border districts (OR = 2.73, 95% CI: 1.65–4.59). In multivariate logistic regression analysis, three factors remained significantly associated with rabies detection: clinical surveillance submission (adjusted OR = 57.32, 95% CI: 23.46–173), owned animal status (adjusted OR = 6.94, 95% CI: 4.04–11.86), and residence in border districts (adjusted OR = 2.24, 95% CI: 1.06–4.81).

Discussion

The continuous detection of rabies cases throughout the study period indicates ongoing virus circulation in the animal population, consistent with global and regional reports that dog-mediated rabies remains endemic in many parts of Asia [1–3]. Dogs were the primary reservoir in this study, in line with established epidemiological evidence identifying domestic dogs as the main source of transmission to humans and other animals in endemic regions [2,3]. Clinical surveillance submissions showed markedly higher positivity rates than samples submitted for rabies-free area certification. This finding reflects the characteristics of passive, symptom-based surveillance systems, which primarily capture animals showing clinical signs or involved in exposure incidents. Such systems are known to have high sensitivity for detecting suspected cases but may not represent the true disease prevalence in the population [4]. The higher detection rate among owned animals should be interpreted with caution, as it likely reflects surveillance bias rather than a true increase in infection risk. Owned animals are more likely to be observed and submitted for laboratory testing when abnormal behaviour occurs, whereas infected stray animals may die unnoticed outside the surveillance system. Similar limitations of passive rabies surveillance have been reported in previous studies and international guidelines [4,5]. Animals residing in border districts showed significantly higher detection rates, highlighting the epidemiological importance of transboundary areas. Border regions often experience frequent movement of animals across administrative or national boundaries, increasing the risk of disease introduction and spread [6,7]. These findings support the need to strengthen surveillance and vaccination programs in border areas as part of integrated One Health strategies [5,7]. Overall, the findings demonstrate both the strengths and limitations of the current surveillance system. Passive surveillance is effective for detecting clinically suspected cases and guiding immediate control measures, but it is prone to selection and detection biases and may not accurately reflect the true epidemiological situation [4]. Strengthening active surveillance, particularly among stray and wildlife populations and in border districts, would improve the representativeness and effectiveness of the rabies surveillance system and support national and global elimination goals [1,7].

Conclusion

Rabies continues to circulate in the animal population of Sa Kaeo Province. Clinical surveillance, ownership status, and border location were key factors associated with detection. Strengthening both passive and active surveillance systems, particularly in border areas, is essential for sustainable rabies control and elimination.

Keywords: Epidemiology, Rabies, Surveillance, Thailand, Transboundary.

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