



Research Article

Rabies in Iraq: Gaps in Surveillance, Prevention, and Control – A Narrative Review

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Abstract

Rabies is a highly fatal zoonotic viral disease that continues to pose a significant public health threat, particularly in low- and middle-income countries such as Iraq. Despite the existence of safe and effective vaccines for both humans and animals, rabies remains a major cause of preventable mortality due to weaknesses in disease surveillance, insufficient prevention strategies, and inconsistent implementation of control measures. Iraq presents a complex epidemiological landscape where rabies persists, driven by factors including political instability, under-resourced veterinary services, inadequate reporting systems, and a rapidly growing population of stray dogs. Human rabies cases are frequently underreported, and animal surveillance remains minimal, limiting the ability to accurately assess the burden of the disease and to design targeted interventions. This narrative review critically examines the current epidemiology of rabies in Iraq, highlighting gaps in surveillance, prevention, and control measures. By synthesizing data from peer-reviewed literature, governmental reports, and guidance from international health organizations such as the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH), the review identifies systemic weaknesses that hinder progress toward rabies elimination. Key challenges include insufficient dog vaccination coverage, delays in post-exposure prophylaxis administration, low public awareness regarding bite prevention, and fragmented coordination between human and veterinary health sectors. The review also emphasizes the importance of adopting a One Health approach, integrating human, animal, and environmental health initiatives to enhance disease monitoring, improve vaccination strategies, and promote community engagement. Strengthening surveillance systems, expanding dog vaccination campaigns, ensuring timely access to post-exposure prophylaxis, and implementing comprehensive public education programs are essential steps to reduce the burden of rabies in Iraq and move toward the global goal of zero human deaths from dog-mediated rabies by 2030.

Keywords

Rabies Iraq Zoonotic Diseases, Surveillance Gaps, Dog Bites, Post-exposure Prophylaxis, One Health Public Health

1. Introduction

Rabies is a fatal zoonotic viral disease caused by the rabies virus (RABV), a neurotropic virus belonging to the genus *Lyssavirus* within the family *Rhabdoviridae* [5]. The virus primarily targets the central nervous system, and once

clinical symptoms manifest, the disease is almost invariably fatal, with mortality approaching 100% in untreated cases [12]. Globally, rabies remains a neglected public health problem, responsible for an estimated 59,000 human deaths

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Received: 24 September 2026; Accepted: 5 October 2026; Published: 31 October 2026



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annually, with the majority occurring in low- and middle-income countries in Asia and Africa [1, 9]. Domestic dogs are responsible for more than 99% of human rabies cases worldwide, making canine rabies control a cornerstone for reducing human mortality [25].

Despite the availability of effective preventive measures, including timely post-exposure prophylaxis (PEP) and mass dog vaccination, rabies continues to persist in regions with weak healthcare systems, limited veterinary infrastructure, and poor public awareness [7, 27]. Post-exposure prophylaxis, which includes immediate wound cleaning, administration of rabies immunoglobulin for severe exposures, and a series of rabies vaccine doses, is highly effective when properly administered. However, delays in presentation, incomplete vaccination courses, and restricted access to immunoglobulin significantly reduce its effectiveness, particularly in resource-limited settings [1, 12]. Iraq represents a unique epidemiological setting for rabies, where the disease persists despite the availability of vaccines. The country is considered endemic for rabies, with reported human cases and dog bite incidents occurring annually [13]. Nevertheless, the true burden of rabies in Iraq is likely substantially underestimated due to underreporting, limited laboratory confirmation, and fragmented surveillance systems [14]. Political instability, prolonged periods of conflict, population displacement, and insufficient investment in public health infrastructure have further complicated rabies prevention and control efforts [23]. The collapse of veterinary services during conflict periods resulted in reduced dog vaccination campaigns and uncontrolled growth of stray dog populations, which serve as the main reservoir for the virus [4, 17].

Additionally, gaps in public awareness exacerbate the problem. Many individuals in rural and peri-urban areas lack knowledge about rabies transmission, appropriate wound management, and the necessity of seeking timely medical care following animal bites [14]. Misconceptions about rabies and

reliance on traditional healing practices often delay treatment, increasing the risk of fatal outcomes [13]. Fragmented coordination between human health and veterinary sectors further limits the implementation of integrated rabies control strategies, despite international recommendations emphasizing a One Health approach, which integrates human, animal, and environmental health for effective disease control [3, 30]. This narrative review aims to provide a comprehensive assessment of rabies epidemiology in Iraq, critically examining gaps in surveillance, prevention, and control measures. It synthesizes data from peer-reviewed literature, national reports, and international health organizations to identify systemic weaknesses that hinder rabies elimination. Furthermore, the review discusses the role of the One Health approach in addressing rabies as a multisectoral challenge and proposes evidence-based strategies for reducing the burden of rabies in Iraq, including strengthening surveillance systems, expanding dog vaccination programs, improving access to post-exposure prophylaxis, and enhancing public awareness and education programs [9, 28].

2. Global Burden of Rabies

Rabies causes an estimated 59,000 deaths annually worldwide, with the highest incidence in Asia and Africa [9, 30]. Children under 15 years are disproportionately affected, accounting for up to 40% of all victims [30]. The disease imposes significant economic burdens, including medical costs, lost productivity, and premature mortality, estimated at USD 8.6 billion per year [27]. Post-exposure prophylaxis (PEP) is highly effective when administered promptly. However, limited access to healthcare, reliance on traditional healing, and delayed care contribute to persistent mortality in endemic regions [19].

Table 1. Global Distribution of Human Rabies Deaths (Annual Estimates).

Region	Estimated Deaths	Percentage of Global Deaths	Major Transmission Route
Asia	36,000	61%	Domestic dogs
Africa	21,000	36%	Domestic dogs
Middle East	1,500	2.5%	Domestic dogs
Latin America	500	0.8%	Domestic dogs
Others	0–100	0.2%	Wildlife (rare)

Source: [9, 30].

The “Zero by 30” initiative, launched by WHO, FAO, WOA, and UNICEF, aims to eliminate human deaths from dog-mediated rabies by 2030 through integrated dog vaccina-

tion, improved access to PEP, and public awareness campaigns [28]. Achieving this requires sustained political commitment, adequate funding, and multisectoral collaboration.

3. Virology and Pathogenesis

Rabies virus is a single-stranded, negative-sense RNA virus with a characteristic bullet shape [21]. Infection occurs mainly

through bites or scratches that introduce infected saliva into tissues. After replication in muscle cells, the virus enters peripheral nerves and moves retrogradely to the central nervous system [5].

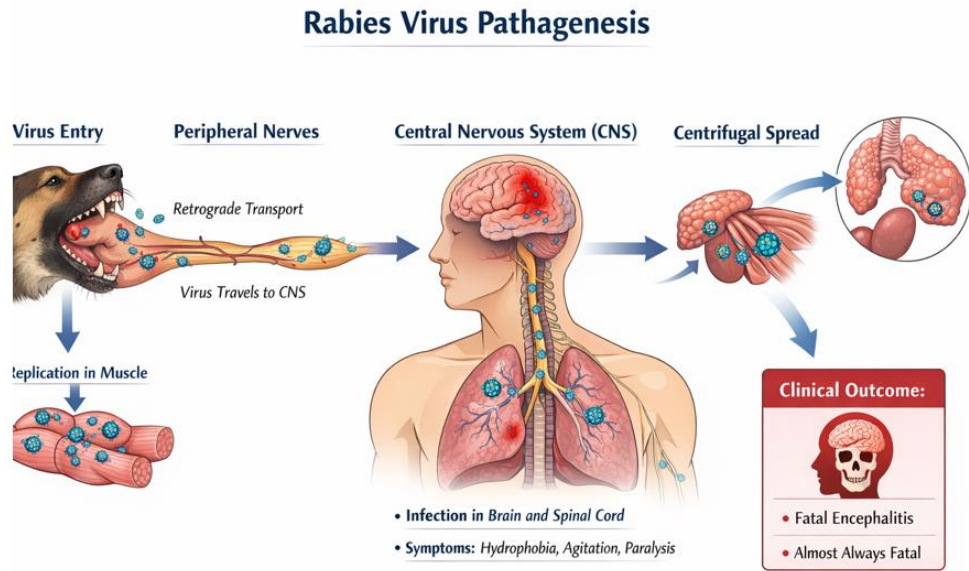


Figure 1. Rabies Virus Pathogenesis (Conceptual Diagram).

Upon reaching the CNS, rabies causes encephalitis, characterized by neuronal dysfunction rather than widespread neuronal death, explaining severe neurological symptoms such as hydrophobia, aerophobia, agitation, hallucinations, and paralysis [12]. The virus subsequently spreads centrifugally to salivary glands, facilitating transmission to new hosts.

Incubation periods range from a few weeks to several months and are influenced by bite location, viral load, and host immune response. This period represents a critical window for effective PEP administration [12].

4. Global Epidemiology of Rabies

Rabies remains a significant public health challenge worldwide, particularly in low- and middle-income countries [9, 25]. Despite elimination in several high-income countries through sustained dog vaccination, animal control policies, and effective surveillance, the disease continues to persist in large parts of Asia, Africa, and the Middle East.

Globally, over 3.3 billion people live in rabies-endemic areas, with domestic dogs accounting for more than 99% of human cases [9]. Wildlife reservoirs, such as bats, foxes, and raccoons, play a more prominent role in high-income countries but are relatively uncommon in endemic regions [5].

Table 2. Human Rabies Cases and Deaths by Region (2010–2020 Estimates).

Region	Estimated Cases	Estimated Deaths	Primary Reservoir	Notes
Asia	59,000	36,000	Domestic dogs	High rural exposure; children at higher risk
Africa	25,000	21,000	Domestic dogs	Underreporting common; limited PEP access
Middle East	2,000	1,500	Domestic dogs	Political instability affects control
Latin America	1,000	500	Domestic dogs	Effective dog vaccination programs
Europe/North America	50–100	<10	Wildlife	Dog-mediated rabies largely eliminated

Sources: [9, 25, 30]

Children are disproportionately affected in endemic regions, often accounting for up to 40% of rabies fatalities [30]. Factors contributing to high incidence include frequent contact with dogs, lack of awareness about bite risk, and delayed healthcare access.

Underreporting is a major challenge, as deaths occurring outside healthcare settings are rarely laboratory confirmed, leading to significant underestimation of the true burden [19, 25].

5. Rabies in the Middle East

The Middle East exhibits heterogeneous rabies epidemiology, reflecting differences in surveillance capacity, vaccination coverage, stray dog populations, and political stability [23]. While some countries have made progress through structured vaccination programs and improved surveillance, others struggle with persistent transmission and insufficient data.

Dog-mediated rabies is the primary form of transmission. Cultural attitudes toward dogs, weak enforcement of animal welfare legislation, and reliance on culling rather than vaccination have hindered control efforts [13].

Table 3. Reported Rabies Cases in Selected Middle Eastern Countries (2015–2020).

Country	Human Cases	Dog Bite Incidents	Dog Vaccination Coverage (%)	Notes
Iraq	50–100	5,000–7,000	<30%	Surveillance fragmented; underreporting
Iran	30–50	3,500–5,000	50–60%	Effective campaigns in urban areas
Jordan	10–20	1,200–1,500	60–70%	Strong dog vaccination; low human deaths
Saudi Arabia	5–10	800–1,000	>70%	Mostly controlled; wildlife spillover rare
Lebanon	15–25	900–1,200	40–50%	Political instability affects coverage

Sources: [13, 23, 30].

Cross-border movement of animals and humans, coupled with population displacement due to conflict, complicates rabies control in the region. Effective surveillance and vaccination campaigns require regional coordination and adoption of the One Health framework.

6. Rabies in Iraq

Iraq is considered endemic for rabies, with sporadic human cases and frequent dog bites reported annually. The true burden is likely higher than reported due to underreporting, limited laboratory confirmation, and fragmented surveillance [13,

14].

6.1. Historical Overview

Rabies has been present in Iraq for decades. Historical records indicate both human and animal cases since the mid-20th century [13]. Political instability, prolonged conflict, and economic sanctions severely disrupted public health and veterinary services, allowing stray dog populations to grow and perpetuate rabies transmission [14].

Routine dog vaccination declined during periods of instability, and public awareness of post-bite care decreased, further exacerbating disease risk.

Table 4. Human Rabies Cases and Dog Bites in Iraq (2000–2020).

Year	Reported Human Rabies Cases	Reported Dog Bites	Notes
2000	45	5,200	Urban centers most affected
2005	60	6,500	Conflict impacts reporting and healthcare access
2010	55	6,000	Vaccination campaigns limited
2015	50	5,800	Data fragmented across governorates

Year	Reported Human Rabies Cases	Reported Dog Bites	Notes
2020	48	5,900	Likely underreported; rural cases missing

Sources [13, 14].

6.2. Current Challenges

- 1) Human Cases: Mostly detected clinically; laboratory confirmation is limited. Children and males in urban/peri-urban areas are at higher risk.

2) Dog Bites: Stray dogs are the main source, especially in cities with poor waste management. Delays in seeking PEP are common, particularly in rural areas.

3) Animal Surveillance: Extremely limited; most suspected rabid animals are not tested. Domestic dogs remain the primary reservoir, with sporadic cases in livestock and wildlife.
- The absence of accurate animal data hampers targeted intervention and results in reactive rather than proactive control measures.

7. Rabies Surveillance Systems in Iraq

Effective rabies control relies heavily on robust surveillance systems capable of detecting cases early, monitoring

trends, and guiding public health interventions [30]. In Iraq, rabies surveillance is fragmented, passive, and under-resourced, limiting its effectiveness [13, 14].

7.1. Human Surveillance

- 1) Primarily clinic-based, relying on clinical diagnosis and history of animal exposure.

2) Laboratory confirmation is limited to a few facilities; most suspected cases are not confirmed [30].

3) Inconsistencies across governorates lead to underreporting and misclassification.

7.2. Animal Surveillance

- 1) Surveillance for rabies in dogs and livestock is weak or virtually absent.

2) Veterinary reporting systems are poorly integrated with human health data, resulting in siloed datasets [13].

Table 5. Comparison of Rabies Surveillance Indicators in Iraq vs WHO Recommendations.

Indicator	WHO Recommendation	Iraq Status	Gap Description
Laboratory confirmation	>80% of suspected human cases	<10%	Very low lab testing capacity
Integrated human-animal data	Fully integrated database	Minimal integration	Siloed human and veterinary data
Active surveillance	Targeted high-risk area monitoring	Rare	Mostly passive reporting
Dog population monitoring	Annual census and vaccination coverage	None systematic	Stray dog population unknown
Timely data reporting	Weekly/monthly reporting	Sporadic	Delays hinder rapid response

Sources: [13, 14, 30]

The fragmented surveillance system hampers early detection, resource allocation, and evaluation of control measures. Without reliable data, rabies remains a low-priority health concern.

8. Diagnostics and Laboratory Challenges

Laboratory confirmation is crucial for accurate surveillance

- and molecular epidemiology [21]. In Iraq:
- 1) Only a few laboratories can perform confirmatory tests such as DFA or PCR.

2) Many human cases remain unconfirmed due to logistical issues, lack of specimen collection, biosafety concerns, and inadequate access to testing facilities [13].

3) Animal diagnostics face even greater limitations, resulting in suspected rabid animals rarely being tested.

Table 6. Diagnostic Capacity for Rabies in Iraq.

Laboratory Type	Capability	Number in Iraq	Key Challenges
Human rabies confirmation	DFA, PCR	3–5	Limited reagents and trained personnel
Animal rabies testing	DFA, Histopathology	1–2	Inadequate equipment and biosafety
Molecular epidemiology	Viral sequencing, RT-PCR	0	No systematic viral characterization

Sources: [13, 18].

The lack of laboratory confirmation limits molecular epidemiology, hindering Iraq’s contribution to regional and global understanding of rabies virus evolution and cross-border transmission.

9. Underreporting and Misclassification

Underreporting is a global challenge, particularly in low-resource settings [19]. In Iraq:

- 1) Many individuals in rural areas do not seek healthcare after exposure due to cost, distance, or reliance on traditional healing.
- 2) Deaths outside hospitals are rarely reported as rabies.
- 3) Misclassification occurs due to overlap with other neurological diseases (encephalitis, meningitis, tetanus) [10].
- 4) Inconsistent case definitions and reporting practices across governorates exacerbate underestimation of disease burden.

Table 7. Factors Contributing to Rabies Underreporting in Iraq.

Factor	Description	Impact on Surveillance
Limited healthcare access	Rural population lacks nearby clinics	Delays in PEP and case detection
Cultural practices	Traditional healers used instead of hospitals	Cases not officially reported
Diagnostic limitations	Lack of laboratory confirmation	Misclassification of neurological deaths
Fragmented reporting systems	Data not integrated across ministries	Incomplete national statistics

Sources: [13,30.]

10. Post-Exposure Prophylaxis (PEP): Availability and Challenges

PEP is highly effective if administered promptly after exposure [20]. In Iraq:

- 1) PEP is available in public healthcare facilities but access is uneven, especially in rural areas.
- 2) Delayed presentation reduces effectiveness; incomplete vaccination courses are common due to logistical issues.
- 3) Rabies immunoglobulin (RIG) is often in short supply, further reducing protection for high-risk exposures.

Table 8. PEP Access and Challenges in Iraq.

PEP Component	Availability	Challenges
Rabies vaccine	Moderate; urban centers	Supply chain disruptions, incomplete courses
Rabies immunoglobulin	Limited; major hospitals	Shortage, high cost, limited cold chain
Public awareness	Low	Delayed care seeking, traditional remedies
Healthcare worker training	Inconsistent	Improper risk assessment and PEP administration

Sources: [30,14].

11. Dog Vaccination Programs in Iraq

Mass dog vaccination is the cornerstone of rabies control, aiming to achieve at least 70% coverage to establish herd immunity and interrupt transmission [9]. In Iraq:

- 1) Vaccination programs are limited in scope, primarily targeting owned dogs.
- 2) Stray and free-roaming dogs, the main reservoir of rabies, remain largely unvaccinated due to logistical and financial constraints [13].
- 3) Culling is often used as a control measure; however, evidence indicates this is ineffective and may even increase disease transmission by disrupting social dog structures [17].

Table 9. Dog Vaccination Coverage in Selected Iraqi Governorates.

Governorate	Estimated Dog Population	Vaccinated Dogs	Coverage (%)	Notes
Baghdad	50,000	12,000	24%	Mainly owned dogs; limited stray coverage
Basra	30,000	6,500	22%	Urban-focused campaigns
Nineveh	25,000	5,000	20%	Stray dogs largely unvaccinated
Najaf	15,000	4,500	30%	Small-scale municipal campaigns
Erbil	20,000	7,000	35%	Higher coverage due to NGO support

Sources: [16].

The absence of a coordinated national strategy and lack of systematic dog population data remain critical gaps in rabies control.

12. Stray Dog Population Management

Stray dog populations are a major driver of rabies transmission in Iraq. Urban expansion, inadequate waste management, and weak enforcement of animal control regulations contribute to rising numbers [4].

- 1) Current approaches, including culling or poisoning, are ad hoc and ineffective.
- 2) Humane strategies, such as catch-neuter-vaccinate-release (CNVR), have been successfully implemented in other countries to reduce both dog populations and rabies incidence over time [8].
- 3) Community engagement is essential for long-term success, including public education on responsible dog ownership and reporting of aggressive animals.

Table 10. Stray Dog Management Approaches.

Strategy	Implementation in Iraq	Effectiveness	Notes
Culling/poisoning	Widespread	Low	Ethical concerns; may increase dog movement
CNVR (Catch-Neuter-Vaccinate-Release)	Very limited	High	Requires funding, trained personnel, and community involvement
Vaccination campaigns for strays	Minimal	Moderate	Coverage inconsistent, logistical challenges
Public awareness	Low	Indirect	Needed to reduce bites and encourage responsible ownership

Sources: [2].

13. Public Awareness and Health Education

Awareness of rabies transmission, symptoms, and prevention is low in Iraq, especially in rural areas [6].

- 1) Many individuals are unaware of the importance of immediate wound washing and prompt medical attention

- after animal bites.
- 2) Misconceptions about rabies and reliance on traditional healing delay treatment, increasing fatality risk.
- 3) Health education campaigns are limited in scale, with underutilized channels such as schools, media, and community centers.
- 4) Training of healthcare workers is also inadequate, resulting in improper PEP administration.

Table 11. Public Awareness Indicators in Iraq.

Indicator	Status	Gap Description
Knowledge of rabies transmission	Low	Many unaware of dog bite risks
Awareness of PEP necessity	Moderate	Delays in seeking medical care
Media campaigns	Limited	Few campaigns; not nationwide
School-based education	Minimal	Schools underutilized for rabies prevention
Healthcare worker training	Inconsistent	Gaps in risk assessment and PEP administration

Sources: [30]

14. One Health Approach to Rabies Control in Iraq

Rabies is a quintessential One Health disease, requiring coordinated action across human, animal, and environmental sectors [3].

- 1) Integration of surveillance data across sectors is limited in Iraq, reducing early warning capacity.
- 2) Joint risk assessments, coordinated vaccination campaigns, and shared outbreak response are largely absent.
- 3) International guidance emphasizes multisectoral collaboration, community engagement, and policy alignment to achieve sustainable rabies control.

Table 12. One Health Implementation Status in Iraq.

Component	Status in Iraq	Gap Description
Human-animal health integration	Minimal	Data silos prevent effective surveillance
Joint vaccination campaigns	Rare	No national coordination
Policy frameworks	Fragmented	No comprehensive One Health governance
Community engagement	Limited	Few education or reporting programs
Collaboration with international agencies	Emerging	Sporadic; not systematic

Sources: [30,4]

15. Discussion

This narrative review highlights that rabies remains a persistent public health challenge in Iraq, driven primarily by systemic gaps rather than lack of scientific knowledge. Despite availability of effective vaccines and international guidance,

human rabies cases continue to occur annually, and dog bite incidence remains high [23].

Key challenges include:

- 1) Fragmented and passive surveillance systems: Human rabies cases are detected mainly through clinical observation, while animal surveillance is minimal or absent, leading to substantial underreporting [29].

- 2) Inadequate dog vaccination programs: Coverage is far below the WHO-recommended 70% threshold, particularly among free-roaming and stray dogs, which remain the primary reservoir [9].
- 3) Limited access to PEP and RIG: Delays in presentation and incomplete vaccination reduce the effectiveness of post-exposure prophylaxis [11].
- 4) Low public awareness: Misconceptions about rabies transmission and reliance on traditional healers delay medical care, particularly in rural populations [14].
- 5) Weak institutional coordination: Lack of integration between human and veterinary health sectors limits One Health implementation [4].

Comparisons with countries that have successfully eliminated rabies demonstrate that elimination is feasible even in resource-limited settings when sustained political commitment, coordinated vaccination, and public engagement are implemented [26].

16. Policy and Public Health Implications

Rabies control in Iraq should be reframed as a multisectoral development challenge, not solely a veterinary or clinical issue. Effective policies should consider intersections with urban planning, waste management, education, and social behavior [15].

- 1) Strengthening One Health coordination between the Ministry of Health, Ministry of Agriculture, municipalities, and academic institutions could serve as a model for managing other zoonotic diseases.
- 2) Investment in surveillance, vaccination, and public awareness programs would reduce human deaths, lower healthcare costs, and improve community safety.
- 3) Enhanced rabies control aligns with international health regulations and the global “Zero by 30” initiative, potentially attracting technical and financial support from international partners [22, 24]

17. Evidence-Based Recommendations

Based on the findings of this review, the following recommendations are proposed:

17.1. Strengthen Surveillance Systems

- 1) Establish integrated surveillance linking human and animal health sectors.
- 2) Standardize case definitions and reporting protocols across all governorates.
- 3) Expand laboratory capacity for rabies diagnosis, including molecular testing.

17.2. Improve Access to Post-Exposure Prophylaxis

- 1) Ensure uninterrupted supply of rabies vaccines and immunoglobulin nationwide.
- 2) Implement follow-up systems to improve completion rates of PEP regimens.
- 3) Train healthcare workers on risk assessment and WHO-recommended PEP protocols.

17.3. Implement Mass Dog Vaccination

- 1) Develop and fund a national dog vaccination strategy targeting at least 70% coverage.
- 2) Prioritize vaccination of stray and free-roaming dogs using community-based approaches.
- 3) Shift from culling to vaccination-centered control strategies.

17.4. Humane Stray Dog Population Management

- 1) Introduce Catch-Neuter-Vaccinate-Release (CNVR) programs in urban areas.
- 2) Strengthen animal welfare legislation and enforcement mechanisms.
- 3) Engage municipalities and local communities in sustainable dog population management.

17.5. Enhance Public Awareness and Education

- 1) Launch nationwide awareness campaigns on rabies prevention and dog bite management.
- 2) Integrate rabies education into schools and community outreach programs.
- 3) Address cultural misconceptions and promote responsible dog ownership.

17.6. Operationalize the One Health Approach

- 1) Establish a national One Health coordination body for rabies control.
- 2) Promote joint planning, data sharing, and outbreak investigations.
- 3) Collaborate with international organizations to align national efforts with global targets.

18. Conclusion

Rabies in Iraq represents a persistent yet preventable public health challenge. Systemic gaps in surveillance, dog vaccination, public awareness, and institutional coordination allow the disease to persist despite effective vaccines and international guidance.

- 1) Strengthening surveillance systems, expanding dog vaccination coverage, improving access to PEP, and enhancing public awareness are essential components of an effective rabies control program.
- 2) Addressing these gaps will reduce preventable human deaths, strengthen health systems, and contribute to regional disease control efforts.
- 3) Alignment with the global “Zero by 30” initiative provides a clear roadmap toward the elimination of human rabies deaths in Iraq.

With sustained political commitment, community engagement, and One Health implementation, rabies elimination in Iraq is achievable, even in a resource-limited and conflict-affected setting.

Abbreviations

RABV	Rabies virus
CNS	Central Nervous System
PEP	Post-exposure Prophylaxis
RIG	Rabies Immunoglobulin
DFA	Direct Fluorescent Antibody Test
PCR	Polymerase Chain Reaction
RT-PCR	Reverse Transcription Polymerase Chain Reaction
WHO	World Health Organization

Author Contributions

Karar Ali Abdulkhuder: Conceptualization, Investigation, Writing – original draft, Writing – review & editing

Farqad Abdulelah Ali Al-janahi: Investigation, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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