Policy Options for Prevention of Leptospirosis Epidemics: A Scoping Review

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Abstract

Background: Leptospirosis is a widespread zoonotic disease causing over one million cases and 60,000 deaths annually. This review aimed to identify and assess policy options for leptospirosis prevention using the One Health approach and One Health Governance Index (OHGI) framework.

Methods: PubMed, Web of Science, Scopus, and Cochrane Library were searched for full-text academic articles, along with Google Scholar and reference lists from Jan 2008 to Dec 2023. A scoping review was conducted following Arksey and O'Malley's framework and PRISMA-ScR guidelines. Articles were retrieved from major databases using defined keywords. Eligible studies focused on community-based policies for human leptospirosis prevention. Two reviewers independently assessed quality, and data were categorized by One Health domains and analyzed using the OHGI framework.

Results: Forty-two studies were included. Common policy strategies involved sanitation education, medical training, surveillance of humans, animals, and environments, legal controls on exposure sources, infrastructure upgrades, and vaccination. Tools like GIS and climate data supported preparedness. Policy options most addressed rule of law, effectiveness, and equity.

Conclusion: Preventing leptospirosis epidemics demands coordinated, context-specific One Health policies that address implementation gaps and promote equity across vulnerable settings.

Keywords: Public health; Education; Sanitation; One health; Early diagnosis; Environmental monitoring

Introduction

Leptospirosis is a widespread zoonotic disease, especially prevalent in tropical regions with frequent flooding and inadequate sanitation (1). It causes over one million infections and 60,000 deaths annually, with the highest burden in low-resource settings (2). Early diagnosis is challenging due to nonspecific symptoms resembling flu, thereby increasing the risk of widespread outbreaks (3). A recent outbreak in Southern Brazil (May–July 2024), where cases surged from 93 to 958 following floods, highlights the role of climate-related events in triggering epidemics (4). Epidemics typically occur when case numbers exceed expected thresholds (5). Disease prevention involves targeted interventions such as sanitation, education, and vaccination to reduce disease burden and associated risks through primary and secondary efforts (6). Control efforts like

surveillance and treatment are part of broader prevention (7).

To reduce outbreak risks, policies must prioritize early detection, intersectoral collaboration, and integration of leptospirosis into both health and environmental strategies (8). This review identifies and evaluates policy options for preventing human leptospirosis epidemics, categorized by the One Health approach, linking human, animal, and environmental health, and analyzed using the One Health Governance Index (OHGI) framework.

Materials and Methods

The scoping review methodology was utilized based on the guidelines outlined within Arksey and O'Malley (9). The results were reported using the Preferred Reporting Items for Scoping Reviews (PRISMA-ScR) (10).

Search strategy

PubMed, Web of Science, Scopus, and Cochrane Library were searched for full-text academic articles, along with Google Scholar and reference lists. Relevant studies were identified using specific keyword search terms: ("leptospirosis" OR "leptospiroses" OR "Leptospira") AND ("prevent" OR "preventability" OR "preventable" OR "preventative" OR "preventatively" OR "preventatives" OR "prevented" OR "preventing" OR "prevention and control" OR ("prevention" AND "control") OR "prevention and control" OR "prevention" OR "preventive" OR "preventively" OR "prevents" OR "controling" OR "controllability" OR "controllable" OR "controllably" OR "controller" OR "controlling" OR "prevention and control" OR "control" OR "control groups" OR ("control" AND "groups") OR "control groups"). The database search covered January 2008 to December 2023 and included only academic journal articles. Citations were exported to Endnote, deduplicated, and screened by title and abstract for relevance to the scoping review's objectives.

Eligibility criteria

The eligibility criteria for articles are presented in Table 1.

Table 1: Inclusion and exclusion criteria for identified articles

Inclusion Criteria	Exclusion Criteria
• Articles focused on human leptospirosis or animal leptospirosis but related to human leptospirosis • The article must present community-based policy options to prevent leptospirosis • No limit on article types • Language restricted to English (Including articles with English abstracts)	• Articles focused on animal leptospirosis unrelated to human leptospirosis • Articles presented individual recommendations for leptospirosis prevention • Reported general policy options without sufficient data for leptospirosis prevention • Non-peer-reviewed papers

Data quality assessment

Two independent reviewers assessed the methodological quality of included studies using tools appropriate to each design. The Mixed Methods Appraisal Tool (MMAT), which includes five design-specific criteria for each study type, was used for qualitative studies, quantitative randomized controlled trials, quantitative non-randomized studies, quantitative descriptive studies, and mixed methods studies, with results reported as the number of criteria met (e.g., "4 out of 5 criteria met") (11).

Narrative reviews were assessed using the Scale for the Assessment of Narrative Review Articles (SANRA) tool, which scores six criteria from 0 to 2, for a total of 12 (12).

Editorials and opinion papers were assessed using the JBI Critical Appraisal Checklist for Text and Opinion Papers, which consists of six criteria (13). As with MMAT, we did not assign scores

but reported how many criteria were met for each paper. Similarly, for economic evaluations, the CASP Checklist for Economic Evaluations (12 criteria) was applied, and the number of criteria met was noted (14).

Data extraction, characterization, and analysis

Two authors independently extracted data using a custom Excel form, capturing author, year, title, country, study type, One Health category, indicators of OHGI system, and policy options. A qualitative synthesis was conducted, categorizing papers into human, animal, and environmental health based on the One Health framework (15). Moreover, papers were categorized according to

One Health governance index (OHGI) system which contains eight indicators including rule of law, equity and inclusiveness, effectiveness and efficiency, political support, responsiveness, participation, consensus-oriented, and transparency (16).

Results

After removing duplicates, our searches identified a total 2898 academic records. In total, 42 publications were included in this review (PRISMA diagram in Fig. 1).
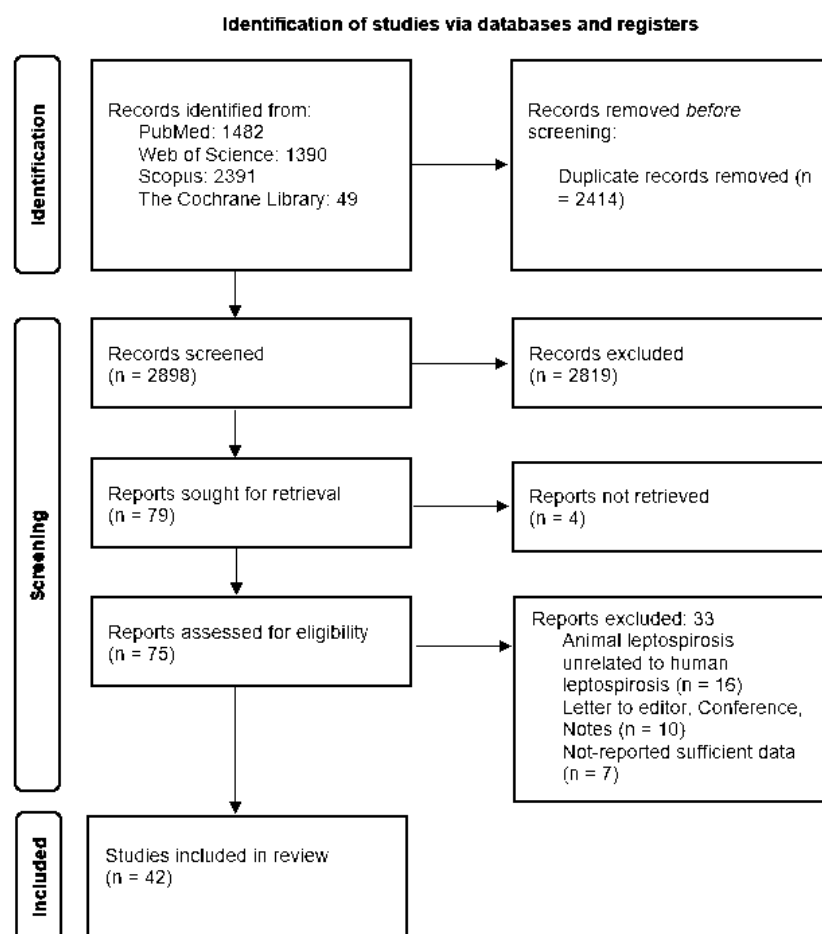
Identification of studies via databases and registers

Fig. 1: PRISMA 2020 diagram

General characteristics

The general characteristics of included studies are presented in Table 2.

Table 2: General characteristics of included studies

Authors	Year	Country	Study type	One Health category
Azfar et al. (17)	2018	Malaysia	Cross-sectional	Human
Viroj et al. (18)	2019	Thailand	Cross-sectional	Human
Allwood et al. (19)	2014	Jamaica	Cross-sectional	Human
Liverpool et al. (20)	2008	Guyana	Case report	Human
Sethi et al. (21)	2010	Northern India	Cohort	Human
Chiu et al. (22)	2009	Taiwan	Case report	Human
Bhardwaj et al. (23)	2008	India	Case-control	Human
Mgode et al. (24)	2021	Tanzania	Cross-sectional	Human- Animal
Biscornet et al. (25)	2020	Seychelles	Cohort	Human- Animal
Desai et al. (26)	2016	India	Case-control	Human- Animal
Bracho et al. (27)	2010	Cuba	Cohort	Human
Jacobs (28)	2018	Not reported	Review	Human
Brockmann et al. (29)	2010	Germany	Cohort	Human
Chadsuthi et al. (30)	2022	Thailand	Case report	Human
Chusri et al. (31)	2012	Thailand	Cohort	Human
Fischer and Flores Somarriba (32)	2017	Not reported	Review	Human
Ratsitorahina et al. (33)	2015	Madagascar	Cross-sectional	Human
Ludwig et al. (34)	2017	Germany	Case report	Human
Suárez Conejero et al. (35)	2015	Cuba	Review	Human, Animal, Environmental
Owers et al. (36)	2018	Brazil	Cross-sectional	Human
Jobbins et al. (37)	2014	Northern Botswana	Cross-sectional	Human
Davoust et al. (38)	2008	France	Review	Animal
Day (39)	2016	Not reported	Editorial	Animal
Diaz (40)	2014	Not reported	Review	Animal
Koizumi et al. (41)	2022	Cambodia/Vietnam	Cross-sectional	Animal
Richardson et al. (42)	2019	Brazil	Quasi-experimental	Animal
Rao (43)	2020	India	Cross-sectional	Animal
Pertile et al. (44)	2022	Brazil	Quasi-experimental	Animal
Okosun et al. (45)	2016	Not reported	Mathematical modeling combined with cost-effectiveness analysis	Animal
Benacer et al. (46)	2013	Malaysia	Cross-sectional	Environmental
Suwannin et al. (47)	2023	Not reported	Review	Environmental
Briskin et al. (48)	2019	Puerto Rico	Cross-sectional	Environmental
Buffon et al. (49)	2018	Brazil	Ecological study	Environmental
Cardwell et al. (50)	2016	England and Wales	Randomized controlled trial (RCT)	Environmental
Casanovas-Massana (51)	2018	Brazil	Cross-sectional	Environmental
Cucchi et al. (52)	2019	China	Time-series	Environmental
Djati et al. (53)	2020	Indonesia	Mixed-method	Environmental
Edre et al. (54)	2018	Malaysia	Cross-sectional	Environmental
Shojaee et al. (55)	2015	Iran	Cross-sectional	Environmental
Emmanuel (56)	2020	Saint Lucia	Mixed-method	Environmental
Feuer et al. (57)	2011	USA	Case report	Environmental
Nursitasari et al. (58)	2019	Indonesia	Case-control	Environmental

Highlights of included studies

1. **Geographic Spread:** Studies cover 25 countries, with clusters in Brazil, India, Malaysia, and Thailand, showing global and context-specific relevance.
2. **Study Designs:** Mostly observational including 14 cross-sectional and five cohort studies, alongside, reviews, case reports, experimental, and modeling approaches.
3. **One Health Focus:**

- Human health: 17 studies
- Animal health: 8
- Environmental health: 13
- Integrated/combined: 4
- **Timeline:** Publications span 2008–2023

The included studies (2008–2023) spanned four continents including America, Europe, Africa, and Asia, with most conducted in Asia. Study designs varied widely across included articles. 17 studies focused on human health policy options (17-23, 27-34, 36, 37), eight on animal health (38-45), and 13 on environmental health (46-58). Three addressed both human and animal health (24-26), and one covered all three One Health domains (35).

Data quality assessment

Overall, 42 studies were assessed using design-specific tools: MMAT, SANRA, the CASP Checklist for Economic Evaluations, and the JBI Critical Appraisal Checklist for Text and Opinion Papers.

Seventeen studies met all criteria, indicating high methodological quality (23, 25, 26, 30, 35, 37, 39, 42, 44, 46, 49, 51-54, 57, 58). 15 studies met four out of five MMAT criteria, often missing Criterion 4 on data analysis (17-19, 21, 22, 24, 27, 31, 34, 36, 41, 48, 50, 55, 56). Four studies met only 2–3 criteria, reflecting lower quality (20, 29, 33, 43).

Among narrative reviews, SANRA scores ranged from five to twelve out of a possible twelve (28, 32, 35, 40, 47). Most reviews received scores of ten or higher, reflecting high quality (32, 35, 40, 47), while one review scored five, indicating notable weaknesses in structure, argumentation, or referencing (28). JBI- and CASP-assessed studies met all criteria (39, 45).

Overall, evidence quality ranged from moderate to high, with some limitations in analysis and reporting. The results of data quality assessment are detailed in Table 3.

Table 3: Results of data quality assessment

Study	Appraisal tool used	Criteria Met / Total (SANRA Score Where Applicable) [Unmet Criteria]
(17)	MMAT	4/5[4]
(18)	MMAT	4/5[4]
(19)	MMAT	4/5[4]
(20)	MMAT	2/5[2, 3,4]
(21)	MMAT	4/5[4]
(22)	MMAT	4/5[5]
(23)	MMAT	Fulfilled
(24)	MMAT	4/5[4]
(25)	MMAT	Fulfilled
(26)	MMAT	Fulfilled
(27)	MMAT	4/5[4]
(28)	SANRA	5/12[1,2,4=1 score/ 3,5=0]
(29)	MMAT	2/5[1,3,4]
(30)	MMAT	Fulfilled
(31)	MMAT	4/5[4]
(32)	SANRA	10/12[3=0 score]
(33)	MMAT	3/5[1,4]
(34)	MMAT	4/5[2]
(35)	SANRA	Fulfilled
(36)	MMAT	4/5[1]
(37)	MMAT	Fulfilled
(38)	MMAT	9/12[2=1 score/ 3=0 score]
(39)	JBI Critical Appraisal Checklist for Text and Opinion Papers	Fulfilled
(40)	SANRA	10/12[3=0]

Table 3: Continued…

(41)	MMAT	4/5[4]
(42)	MMAT	Fulfilled
(43)	MMAT	2/5[2,3,4]
(44)	MMAT	Fulfilled
(45)	CASP Checklist for Economic Evaluations	7/12[4, 5, 6, 9, 11]
(46)	MMAT	Fulfilled
(47)	SANRA	10/12[3= 0 score]
(48)	MMAT	4/5[1]
(49)	MMAT	Fulfilled
(50)	MMAT	4/5[4]
(51)	MMAT	Fulfilled
(52)	MMAT	Fulfilled
(53)	MMAT	Fulfilled
(54)	MMAT	Fulfilled
(55)	MMAT	4/5[4]
(56)	MMAT	4/5[5]
(57)	MMAT	Fulfilled
(58)	MMAT	Fulfilled

Data analysis

Based on the scoping review conducted by the research team and by using One Health approach, policy options were divided into three categories:

1. Human health
2. Animal health
3. Environmental health

Besides, papers were categorized according to One Health governance index (OHGI) system which contains eight indicators including rule of law, equity and inclusiveness, effectiveness and efficiency, political support, responsiveness, participation, consensus-oriented, and transparency (16). After reviewing articles and available evidence, 40 policy options were found (Table 4).

Table 4: Policy options to prevent leptospirosis epidemics

One Health category	Indicators of OHGI system	Policy options
	Rule of law	Mandatory protective equipment use for high-risk workers in endemic areas (17, 18)
	Participation	Public and medical training programs to improve awareness, diagnosis, and treatment (18-22)
	Equity and inclusiveness, Responsiveness	Fever surveillance as part of pre-monsoon preparedness (23, 24)
	Responsiveness	Dissemination of intensive IEC (Information, Education, Communication) messages (23)
	Equity and inclusiveness, Effectiveness and efficiency	Monitoring at-risk individuals, especially those with animals nearby or with skin diseases (25, 26).
Human health	Equity and inclusiveness, Effectiveness and efficiency, Participation	Ongoing education for occupational groups on proper personal protective equipment usage (25)
	Effectiveness and efficiency	Promotion of homeopathic prevention methods (27, 28)
	Equity and inclusiveness, Responsiveness	Screening after floods or storms in high-risk zones (22, 29)
	Effectiveness and efficiency, Responsiveness	Establishment of leptospirosis early warning systems (30)
	Equity and inclusiveness	Provision of protective gear for athletes in water sports (31)
	Effectiveness and efficiency	Expansion of diagnostic labs in underserved high-risk regions (32, 33)
	Rule of law	Mandatory hygiene for pet rat owners (34)
	Rule of law	Ban on consuming meat/milk from sick or suspect animals (35)
	Rule of law	Prohibition of river immersion in contaminated areas (35)
	Effectiveness and efficiency	GPS tracking of slum residents to reduce exposure (36)
	Rule of law	Ban on wild animal meat consumption (37)
	Effectiveness and efficiency	Use of vaccination and chemoprophylaxis in high-risk communities (35)
	Consensus-oriented	Veterinary diagnosis of domestic animals (25, 35)
	Political support, Consensus-oriented	Creation of units for early animal diagnosis and cross-sector collaboration (38)
Animal health	Rule of law, Effectiveness and efficiency	Monitoring animal movement and screening for infection (39)
	Rule of law, Equity and inclusiveness, Effectiveness and efficiency	Safe disposal of animal feces; ban storage near homes (26, 35)

Table 4: Continued…

	Rule of law	Limit human-rodent contact; safe disposal of rodent droppings (40)
	Effectiveness and efficiency	Habitat management to reduce rodent nesting (40)
	Consensus-oriented	Surveillance of rodent trade (41)
	Political support	Infrastructure to prevent animal access to food/water (35)
	Political support, Participation	Rodent population control campaigns in high-risk zones (42-44)
	Effectiveness and efficiency	Encourage livestock vaccination with local strain vaccines (24, 35, 45)
	Rule of law, Effectiveness and efficiency	Routine soil and water screening to identify hotspots (46, 47)
	Political support	Development of water drainage in flood-prone areas (48)
	Equity and inclusiveness, Responsiveness	Programs to map high-risk individuals and locations (49)
	Equity and inclusiveness, Responsiveness, Participation, Consensus-oriented	Annual joint risk assessments by vets and farmers for biosecurity (50)
Environmental health	Equity and inclusiveness	Sanitation improvements in urban slums (51)
	Effectiveness and efficiency	Safety screening of crops from high-risk zones (52)
	Effectiveness and efficiency, Responsiveness, Transparency	Use of environmental and meteorological data for risk mapping (53)
	Effectiveness and efficiency, Responsiveness, Transparency	GIS tools to monitor and predict outbreaks (54, 55)
	Rule of law, Effectiveness and efficiency	Improve waste management systems (56)
	Political support	Infrastructure to prevent human/animal contact with contaminated water (55, 57)
	Political support	Repair faulty sewage systems in high-risk areas (58)
	Rule of law	Mandatory disinfection of water storage and pools (35)
	Rule of law	Disinfection of crops in high-risk areas (35)

Highlights of policy options

1. Personal protection (e.g., mandatory use of protective equipment, education)
2. Surveillance (e.g., fever tracking, GIS tools)
3. Environmental control (e.g., rodent management, sanitation)
4. Animal health (e.g., vaccination, screening)
5. Infrastructure readiness (e.g., labs, drainage, warning systems)

Policy options from One Health perspective

Common One Health policy options to prevent leptospirosis epidemics include public education, surveillance, infrastructure upgrades, legal controls, and vaccination.

Awareness campaigns and medical staff training support early diagnosis (18-23, 25). Monitoring humans, animals, and environmental sources aids early outbreak detection (25, 26, 38, 46, 47).

Legal measures limit contact with rodents, unsafe water, and unregulated animal products, while regulating animal movement and rodent trade (17, 18, 26, 34, 35, 37, 39-41).

Strengthening diagnostics and building barriers, drainage, and rodent-proof infrastructure reduce exposure (32, 33, 35, 55, 57, 58).

Sanitation improvements, including safe waste and water management, are crucial in high-risk areas (26, 35, 51, 56).

Tools like GIS, GPS, and climate data support outbreak prediction and preparedness (36, 53-55). Vaccination of at-risk humans and animals like dogs, pigs, and cattle offers added protection (24, 35, 45).

Assessment framework of OHGI system

Forty policy options were mapped to the eight OHGI governance indicators. "Rule of law" was most addressed, with mandates on protective gear, hygiene, and exposure restrictions (17, 18, 26, 34, 35, 37, 39, 40, 46, 47, 56). "Effectiveness and efficiency" included diagnostics, chemoprophylaxis, GIS surveillance, and risk assessments (24-28, 30, 32, 33, 36, 39, 40, 45-47, 52-56).

"Equity and inclusiveness" targeted at-risk groups (22-26, 29, 31, 35, 49-51), while "responsiveness" focused on flood-related screening and warnings (22-24, 29, 30, 49, 50, 53-55). "Participation" appeared in education and multisectoral actions (18-22, 25, 42-44, 50). Fewer policies addressed "consensus orientation" (25, 35, 38, 41, 50) and "political support" (35, 38, 42-44, 48, 55, 57, 58). "Transparency" was reflected in the use of GIS and environmental data (53-55).

Interactions among One Health domains and the indicators of the OHGI (One Health Governance Index) assessment framework is presented in Fig. 2.
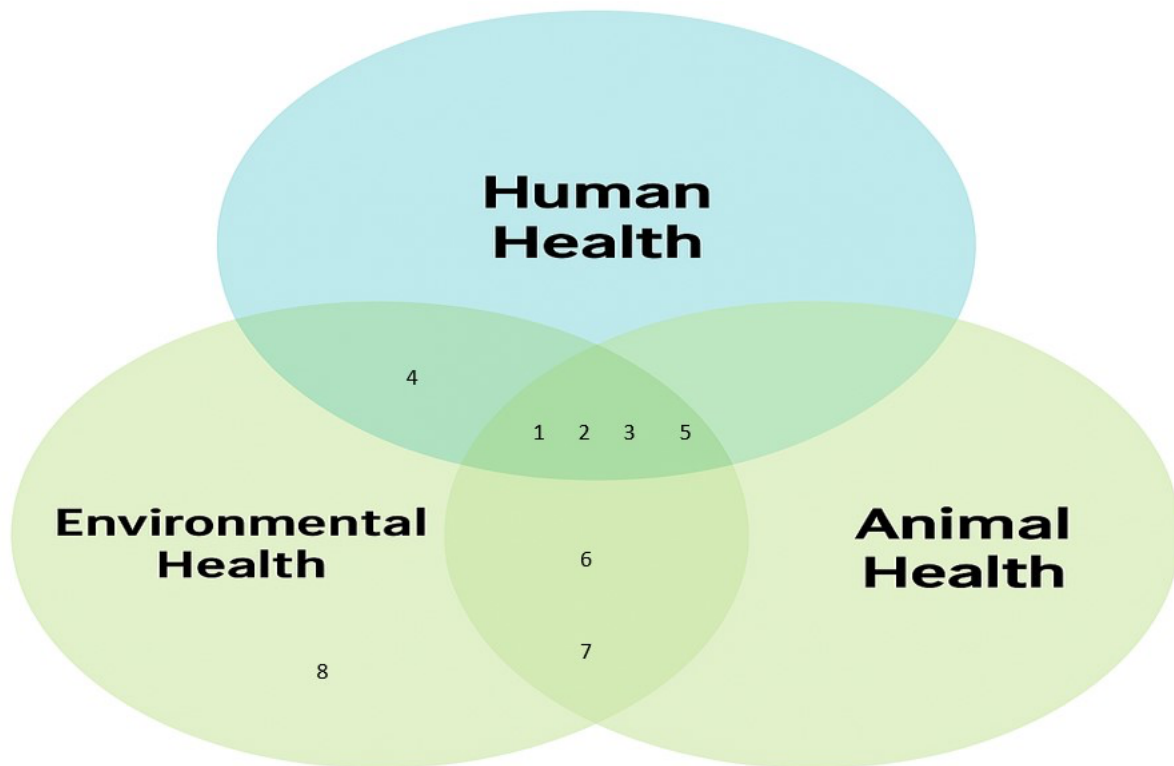

Fig. 2: Interactions among One Health domains and the indicators of the OHGI (One Health Governance Index) assessment framework (1: Rule of law, 2: Participation, 3: Equity and inclusiveness, 4: Responsiveness, 5: Effectiveness and efficiency, 6: Consensus-oriented, 7: Political support, 8: Transparency)

Discussion

Leptospirosis is primarily transmitted through contaminated water or soil (46, 47), with outbreaks often triggered by floods and poor sanitation. This review analyzed 40 policy options from 42 studies, categorized under human, animal, and environmental health.

Education efforts targeting high-risk groups and health professionals are widely supported (18-23, 25), often using local communication channels.

Climate factors, particularly heavy rainfall, are key drivers (59, 60). Pre-rainfall measures include environmental monitoring and risk mapping (23-26, 35, 46, 47, 53), and preparing health systems with adequate resources and stockpiles, while post-rainfall actions emphasize early detection and strengthened reporting systems, case tracking, and rodent control (22, 29, 36, 38, 40, 42-44).

Flood prevention remains critical, with climate change and deforestation elevating risk. Long-term adaptation strategies like reforestation, sustainable land use, and watershed protection are needed (61).

Poor sanitation in informal settlements increases leptospirosis risk, as waste accumulation and feces near homes attract infected rodents, leading to outbreaks (26, 35, 51, 56). Improving waste systems are critical. Top-down measures alone are inadequate. Community involvement ensures culturally appropriate, sustainable solutions (62). Equitable strategies must focus on vulnerable

groups. Investments in local sanitation, rodent-proof housing, and early warning systems also address structural inequalities (30, 43, 63).

Key infrastructures for leptospirosis prevention include clean water systems, green drainage (e.g., rain gardens, permeable pavements) to reduce flooding (48), clinics and labs for early detection (32, 33), and veterinary facilities for animal monitoring and vaccination. Community education and emergency warning systems are crucial in high-risk areas (30). Additional measures include secure food storage and fencing to limit rodent and human contact with contaminated water (35, 55, 57).

Effective regulations are essential for leptospirosis prevention. Measures include regulating rodent trade (41), screening animals in high-risk zones (39), and inspecting imported agricultural products (52). Zoning laws can help prevent contamination near water bodies.

Vaccination for human and animals, especially for cattle, pigs, and dogs, is a key strategy (24, 35, 45). Human vaccination is limited to high-risk groups due to short-lived immunity and adverse reactions, requiring annual boosters (64, 65). To address these challenges, local strain-specific vaccines, adherence to veterinary protocols, and strong post-vaccination monitoring are recommended. Vaccination should focus on clearly identified high-risk groups and animals, with continued research into safer, longer-lasting formulations to minimize health and ecological risks.

Doxycycline chemoprophylaxis is useful post-flooding (35), but widespread use risks antibiotic resistance, side effects, and adherence issues (66, 67). Evidence on post-exposure prophylaxis remains inconsistent, highlighting the need for long-term studies to confirm its safety and effectiveness across populations (68).

Rodent control remains a cornerstone policy (42-44), yet has ecological trade-offs. Rodents are vital to ecosystems, and chemical methods may harm predators and increase human-wildlife conflicts (59, 69). To avoid unintended harms, integrated pest management (IPM), combining habitat control and minimal rodenticides, is advised (70).

Case studies validate many interventions. For instance, rodent control campaigns in Gujarat, India, led to a 61% and 82% reduction in disease prevalence in 2009 and 2012, respectively (43). GPS tracking in Brazilian slums proved valuable in identifying risk zones (36). Vaccination combined with livestock treatment was the most cost-effective strategy (45), and tailored veterinary advice improved farm biosecurity in one RCT (50). More research is needed in underrepresented regions like Africa and Central America.

Emerging technologies like recombinant protein, DND and mRNA vaccines (64, 71), GIS tools, mobile health, and rapid diagnostics, enhance outbreak prediction and response (54, 55, 72, 73). Prevention faces challenges including limited funding (74), low-capacity health systems (32), poor cross-sector coordination, and low community trust (75). Unregulated environmental activities, urbanization, climate change, and lack of localized data further hinder effective policies (59, 60).

OHGI mapping shows strengths in rule of law and effectiveness, but gaps in consensus, transparency, and political support highlight areas needing further research.

Prevention strategies must be context-specific. In Asia and Latin America, frequent floods necessitate education and flood control (76). Africa leans on community-based, low-cost approaches due to weak health systems (77), while Oceania integrates environmental and veterinary sectors due to wildlife and storm-related risks (78). In Europe and North America, where the disease is less common, efforts focus on occupational and pet vaccination (79).

Despite its novel use of the OHGI-One Health lens, this review is limited by variation in study quality and regional contexts. Overgeneralization is a risk, as policy effectiveness depends on factors like climate, infrastructure, and healthcare. For example, chemoprophylaxis may suit high-capacity regions but not low-resource ones. Future research should assess context-specific strategies, compare outcomes across settings, and examine the roles of equity, climate resilience, and community participation in prevention.

Conclusion

Preventing leptospirosis epidemics requires a multisectoral One Health approach. This review identified 40 policy options assessed via the OHGI framework. Key strategies include education, sanitation, flood control, protected water sources, and technologies like GIS and early warnings. Legal measures and targeted interventions also play vital roles. Implementation remains challenged by resource gaps, poor coordination, and social inequities. Future efforts must be context-specific, equitable, and scalable.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Ethics approval and consent to participate

Not applicable.

Conflict of interest

The authors declare that there is no conflict of interests.

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