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Evolving Epidemiology, Diagnostic Challenges, and Public Health Implications of Scrub Typhus - A Narrative Review

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ABSTRACT

Scrub typhus, caused by *Orientia tsutsugamushi* and transmitted through the bite of infected chigger mites, is a significant cause of acute febrile illness in many parts of India. Although historically underdiagnosed, it is now increasingly recognized as a public health concern in several endemic regions, particularly following the monsoon season and natural disasters such as floods. This review aims to examine the epidemiological trends, clinical features, diagnostic challenges, treatment options, and preventive strategies related to scrub typhus in India. It also highlights the current gaps in surveillance, awareness, and healthcare infrastructure that hinder effective control of the disease. A comprehensive literature review was conducted using data from published articles, government reports, and recent surveillance updates to present a holistic view of scrub typhus in India. Early diagnosis, increased clinical awareness, improved diagnostic accessibility, community-based education, and integrated vector control measures are vital to reduce the morbidity and mortality associated with scrub typhus in India.

Keywords

Scrub Typhus, *Orientia tsutsugamushi,* Disease Outbreaks, Diagnosis, Differential

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Introduction

Scrub typhus, caused by the intracellular bacterium *Orientia tsutsugamushi*, has resurfaced as a critical public health concern in India, particularly as a re-emerging cause of acute undifferentiated febrile illness (AUFI).

First reported in India during the early 20th century and notably during World War II and the 1965 Indo-Pakistani war, its clinical relevance diminished for a few decades until a resurgence in the 1990s near the India-Pakistan border (Singh *et al.,* 2004).

In recent years, the disease has shown a widespread and increasing presence across various ecological zones in India, including the northern Himalayan states (e.g., Himachal Pradesh, Uttarakhand), the southern plateau (Tamil Nadu, Andhra Pradesh, Telangana), northeastern states (e.g., Assam, Nagaland), and parts of western and central India such as Rajasthan, Gujarat, and Chhattisgarh (Xu *et al.,* 2017; Mohapatra *et al.,* 2024).

Transmitted to humans through the bite of infected larval mites (chiggers) of the *Trombiculidae* family, scrub typhus typically manifests as a nonspecific febrile illness, which complicates clinical suspicion and diagnosis (Watt and Parola, 2003; Mahajan, 2005). The typical symptom complex includes high-grade fever, headache, myalgia, lymphadenopathy, and occasionally a pathognomonic eschar. If left untreated, it can progress to severe complications such as acute respiratory distress syndrome (ARDS), multi-organ dysfunction syndrome (MODS), and meningoencephalitis, contributing to significant mortality (Chrispal *et al.,* 2010; Sahu *et al.,* 2015; Agrawal *et al.,* 2022; Seong *et al.,* 2001).

A resurgence of confirmed cases and several fatalities during the 2023 outbreaks—particularly in Himachal Pradesh and Odisha—has brought national attention to the disease's growing burden (Mohapatra *et al.,* 2024). In Odisha, simultaneous dengue outbreaks in scrub typhus-endemic districts overwhelmed healthcare resources, although no confirmed co-infections were noted (Devasagayam *et al.,* 2021). However, concurrent infections with other febrile illnesses like typhoid, dengue, or influenza remain a diagnostic challenge, often delaying appropriate treatment (Damodar *et al.,* 2023).

The clinical burden is exacerbated among vulnerable populations, including children and immunocompromised individuals, who are at heightened risk of severe disease and complications (Garg and Manesh, 2021; Varghese *et al.,* 2014). Hospital-based surveillance in southern India has documented pediatric cases presenting with nonspecific symptoms and a significant proportion developing neurological manifestations associated with high mortality (Sahu *et al.,* 2015; Agrawal *et al.,* 2022; Seong *et al.,* 2001).

Despite its rising incidence, scrub typhus remains underdiagnosed due to its overlapping symptoms with other febrile illnesses and limitations in diagnostic access. Traditional diagnostic tools such as the Weil-Felix test suffer from low specificity, whereas newer modalities like IgM ELISA and rapid immunochromatographic tests offer improved sensitivity but are not uniformly available across healthcare settings in India (Sharma *et al.,* 2016; Mathai *et al.,* 2003). Studies evaluating tests like the InBios Scrub Typhus Detect IgM Rapid Test and IFA in Indian settings highlight regional variations in diagnostic accuracy and the need for locally validated, accessible diagnostic protocols (Blacksell *et al.,* 2010; Kim *et al.,* 2014).

Given India's vast ecological diversity, frequent monsoon-driven outbreaks, and the resurgence of cases in both rural and urban centers, there is an urgent need to prioritize scrub typhus surveillance, improve diagnostic capacity, and enhance clinician awareness. Early recognition and prompt initiation of doxycycline or azithromycin therapy can significantly reduce complications and mortality. Therefore, understanding the evolving epidemiology, diagnostic challenges, and public health implications of scrub typhus is crucial in framing effective strategies to combat this neglected tropical infection (Sharma *et al.,* 2005; Chunchanur *et al.,* 2019).

Prevalence of Scrub Typhus in India

Scrub typhus is an increasingly recognized cause of acute febrile illness (AFI) in India, with recent systematic reviews and studies highlighting its significant prevalence across various regions.

A comprehensive systematic review and meta-analysis by Sondhiya *et al.,* (2023) analyzed 60 eligible studies out of 573 identified, encompassing a total of 34,492 febrile cases. The pooled seroprevalence of scrub typhus among acute febrile illness cases was found to be 26.41% (95% CI: 22.03–31.03), indicating a substantial burden. Additionally, the pooled case fatality rate (CFR) from six studies was 7.69% (95% CI: 4.37–11.72), underscoring its clinical severity (Sondhiya *et al.,* 2023).

Further insights are provided by Devasagayam *et al.,* (2021), who reviewed 138 hospital-based and 2 community-based studies conducted over the past decade. This review documented 18,781 confirmed cases of scrub typhus. In studies focusing on acute undifferentiated febrile illness (AUFI), scrub typhus accounted for 25.3% of cases.

Moreover, community-based seroprevalence studies reported a high IgG seroprevalence of 34.2%, suggesting widespread prior exposure in the population. The overall CFR was 6.3%, rising significantly to 38.9% in cases with multiple organ dysfunction syndrome (MODS). Diagnosis in 89% of the studies was established using IgM ELISA, emphasizing its role as the primary diagnostic tool.

In a hospital-based study from South India by Abhilash *et al.,* (2016), scrub typhus emerged as the most common cause of AUFI, accounting for 35.9% of 1,258 patients.

The mortality rate was 4.6%, the highest among all AUFI etiologies. Scrub typhus cases showed a seasonal peak during monsoon and cooler months and were associated with clinical features such as breathlessness (OR: 4.96), leukocytosis >10,000/mm³ (OR: 2.31), and hypoalbuminemia <3.5 g% (OR: 2.32).

Severe complications included bleeding manifestations (4.2%), and a higher need for supplemental oxygen, invasive ventilation, and inotropic support (Abhilash *et al.,* 2016).

Etiology and Transmission of Scrub Typhus

Causative Agent: Scrub typhus is caused by Orientia tsutsugamushi, an obligate intracellular Gram-negative bacterium. Unlike most Rickettsiae, O. tsutsugamushi lacks a typical peptidoglycan cell wall and lipopolysaccharide, contributing to its unique pathogenicity and survival strategy inside host cells, particularly endothelial and phagocytic cells (Kelly *et al.,* 2009).

Vector: The disease is transmitted by the larval stage (chigger) of Trombiculid mites, primarily of the genus Leptotrombidium. These mites thrive in moist, vegetated areas such as forest clearings, grasslands, rice fields, and scrub jungles—conditions commonly found in rural and semi-urban parts of India (Watt and Parola, 2003). The mites attach to the skin, feed on tissue fluids for several days, and transmit the pathogen through their bite.

Reservoir: Small rodents (e.g., rats, voles, and shrews) act as natural reservoirs. The transovarial and transstadial transmission of *O. tsutsugamushi* in mites enables the infection to persist across generations of mites without the need for vertebrate hosts (Paris *et al.,* 2013). In India, rural rodent populations in areas such as Tamil Nadu, Himachal Pradesh, West Bengal, and Uttarakhand have been shown to harbor the infection, supporting ongoing transmission cycles.

Transmission in Humans: Humans are accidental dead-end hosts, typically acquiring infection through the bite of an infected chigger. Infection risk is highest among individuals engaged in outdoor or agricultural activities such as farming, forestry, and military training—common occupational and lifestyle patterns in many Indian states (Watt and Parola, 2003).

Geographical Distribution: Scrub typhus is endemic to the "Tsutsugamushi Triangle," a region extending from northern Japan and far-eastern Russia in the north to northern Australia in the south and Pakistan in the west. In the Indian context, scrub typhus is now widely reported across all geographic regions. In North India, cases have been frequently documented in Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and Uttar Pradesh. In South India, the disease is prevalent in Tamil Nadu, Kerala, Andhra Pradesh, and Karnataka. Eastern and Northeastern states such as West Bengal, Odisha, Assam, Nagaland, and Arunachal Pradesh have also reported significant case numbers. Moreover, the disease has emerged in Central and Western India, including Maharashtra, Chhattisgarh, Gujarat, and Madhya Pradesh (Xu *et al.,* 2017; Mohapatra *et al.,* 2024). The recent expansion of scrub typhus across these diverse geographic regions is likely due to a combination of factors, including increased diagnostic awareness, changes in land use patterns, deforestation, and climate change, which have collectively enhanced human exposure to infected mite vectors.

Public Health Note: Due to nonspecific clinical presentation and limited early diagnostic capacity in many Indian healthcare facilities, scrub typhus often goes unrecognized until complications (e.g., meningoencephalitis, MODS) arise. Enhanced awareness and early doxycycline or azithromycin treatment can significantly reduce morbidity and mortality.

Clinical Features of Scrub Typhus

Incubation Period: The incubation period ranges from 6 to 21 days, with an average of 10–12 days (Mahajan, 2005).

Initial Symptoms: Patients typically present with non-specific symptoms such as fever with chills, headache, myalgia, cough, and vomiting (Chrispal *et al.,* 2010).

Eschar Formation: A characteristic feature of scrub typhus is the presence of an *eschar*—a black, crusted ulcer with a surrounding erythematous halo—though it may not always be visible (Chrispal *et al.,* 2010). The reported prevalence of eschar in patients varies widely (7–80%) due to factors such as difficulty detecting small eschars in individuals with darker skin, strain variations of *Orientia tsutsugamushi*, and atypical presentations in moist body regions (Murhekar *et al.,* 2017). Eschars usually begin as small papules that enlarge and undergo central necrosis, forming a black necrotic lesion.

Common sites include the groin, axillae, waist, and other exposed areas (Sharma *et al.,* 2016). Studies have noted eschars to be commonly found on the chest and within 30 cm of the umbilicus in both sexes. However, males more frequently had eschars on the lower limbs, while females had them on their backs—likely due to differences in clothing and outdoor activities (Varghese *et al.,* 2014).

Other Signs and Symptoms: Rash: Typically maculopapular, beginning on the trunk and spreading to limbs. Lymphadenopathy and hepatosplenomegaly are often noted (Mahajan, 2005). Gastrointestinal symptoms (nausea, vomiting, abdominal pain), cough, fatigue, and muscle pain are common. Severe cases may progress to multi-organ dysfunction syndrome (MODS), affecting the heart, lungs, kidneys, and central nervous system (Li *et al.,* 2019).

Symptom Frequency in Confirmed Cases (Meta-analysis Data from 93 Studies) (Devasagayam *et al.,* 2021)

- ✓ Headache: 18.2%
- ✓ Nausea/Vomiting: 17.1%
- ✓ Abdominal Pain: 10.5%
- ✓ Breathlessness: 10.4%
- ✓ Cough: 10.4%
- ✓ Jaundice: 5.6%
- ✓ Seizures: 2.7%

Fever Characteristics

- ✓ Reported in 65 studies.
- ✓ Median duration: 8.8 days (range 4–14 days).
- ✓ Fever <7 days: 39.1% (24 studies).
- ✓ Fever >14 days: 13.8% (15 studies).

Eschar Prevalence in Confirmed Cases

- ✓ Reported in 94 studies.
- ✓ Present in approximately 22% of cases.

Complications of Scrub Typhus

Scrub typhus can range from mild illness to severe, life-threatening complications involving multiple organ systems. Without treatment, the mortality rate ranges from 6–30%, but drops to <5% with early antibiotic therapy.

- ✓ Central Nervous System: Neurological involvement includes meningitis, meningoencephalitis (14–83%), cerebellitis (11%), acute disseminated encephalomyelitis (ADEM), and cranial nerve palsies such as ptosis and ophthalmoplegia. Hearing loss occurs in up to one-third of patients.
- ✓ Cardiovascular System: Complications include myocarditis, arrhythmias, acute heart failure (62), and even myocardial infarction. Studies have shown reduced ejection fraction (30.9–42.8%) and elevated cardiac biomarkers in 61.7–72.8% of patients. Scrub typhus may trigger atrial fibrillation due to systemic inflammation.
- ✓ Renal System: Acute kidney injury (AKI) occurs in ~19.2% of cases, with albuminuria and hematuria commonly reported. Biomarkers such as NGAL and KIM-1 have shown promise for early detection of AKI in scrub typhus.
- ✓ Respiratory System: ARDS is a major complication (20.5%), often presenting with interstitial pneumonia and type I respiratory failure. Early doxycycline treatment is essential.
- ✓ Gastrointestinal System: Gastrointestinal symptoms include abdominal pain, vomiting, diarrhea, and rarely, peritonitis. Hepatitis is observed in ~40.5% of cases.
- ✓ Hematological & General Complications: Thrombocytopenia (28.4%), shock (16.2%), and MODS (17.4%) are common in severe cases. About 20.4% require ICU admission and 19.1% require ventilation (Sondhiya *et al.,* 2023; Balaji *et al.,* 2014)

Diagnostic Approaches for Scrub Typhus

Clinical Diagnosis: Fever in an endemic area with a pathognomonic eschar is strongly suggestive (Mahajan, 2005).

Laboratory Findings

Common abnormalities include thrombocytopenia, elevated liver enzymes, and leukocytosis or leukopenia.

Thrombocytopenia is especially notable (mean platelet count ~81,000/mm^3) (Sharma *et al.,* 2016).

Serological Tests

Weil-Felix Test: Based on OX-K agglutination; historically used but low sensitivity/specificity (Mathai *et al.,* 2003).

ELISA (IgM/IgG): Offers improved sensitivity and higher throughput (Balaji *et al.,* 2014).

Indirect Immunofluorescence Assay (IFA): Gold standard for diagnosis; detects a dynamic fourfold rise in antibody titers (Blacksell *et al.,* 2010).

Rapid Diagnostic Tests (RDTs)

Detect anti-Orientia IgM/IgG; simple and quick but limited by background seropositivity in endemic areas.

Antigen-capture RDTs are under development for early detection.

Molecular Tests

PCR (targeting 56-kDa, 47-kDa, 16S rRNA, or groEL genes): High specificity and sensitivity, especially useful within the first 10 days of illness when serological tests may be negative.

LAMP (Loop-mediated isothermal amplification): Promising low-cost DNA test requiring minimal equipment; results visually interpreted; further validation needed.

MLST (Multi-locus sequence typing): Useful for strain typing and epidemiological studies, though not widely applied to *Orientia tsutsugamushi* yet (Sharma *et al.,* 2016).

Eschar Sampling: Eschar swabs or crusts are non-invasive and contain high bacterial loads, ideal for molecular detection even post-treatment (Balaji *et al.,* 2014).

Culture: Culturing *O. tsutsugamushi* is rarely done due to biosafety level 3 requirements and slow growth; not feasible in routine practice (Kelly *et al.,* 2009).

Management and Treatment

The cornerstone of scrub typhus management is prompt initiation of appropriate antibiotic therapy, as delayed treatment can lead to serious complications such as acute respiratory distress syndrome (ARDS), meningoencephalitis, hepatic dysfunction, and multiorgan failure. Doxycycline is the first-line antibiotic of choice, typically administered at a dose of 100 mg twice daily for 7–10 days. It is highly effective, with patients often showing clinical improvement and defervescence within 48–72 hours. However, doxycycline is contraindicated in pregnant women and children under 8 years of age, in whom azithromycin is preferred due to its safety profile. Azithromycin is usually given as 500–1000 mg on the first day followed by 250–500 mg daily for two more days. Chloramphenicol**,** although effective, is rarely used due to the risk of bone marrow suppression and aplastic anemia. In areas reporting doxycycline resistance, such as northern Thailand, rifampicin has shown superior efficacy, although it should be used with caution and only after excluding co-infection with tuberculosis, as it is also a key anti-tubercular drug. In severe or treatment-resistant cases, combination therapy with doxycycline and azithromycin or chloramphenicol may be considered (Varghese *et al.,* 2006).

Supportive Care and Importance of Early Diagnosis and Treatment in Scrub Typhus

Supportive care plays a vital role in the overall management of scrub typhus, especially in cases presenting with moderate to severe complications. The disease often begins with non-specific symptoms such as fever, headache, myalgia, and malaise, which can be easily mistaken for other endemic febrile illnesses like dengue, malaria, or leptospirosis. As scrub typhus progresses, it can lead to severe systemic complications such as acute respiratory distress syndrome (ARDS), meningoencephalitis, acute kidney injury, hepatitis, myocarditis, coagulopathy, and multiorgan dysfunction syndrome (MODS). Therefore, early clinical suspicion and laboratory confirmation are crucial in initiating prompt therapy and preventing fatal outcomes.

Supportive management begins with symptomatic relief. Antipyretics, such as paracetamol, help in controlling high-grade fever and improving patient comfort. Intravenous fluid therapy is essential to correct dehydration, maintain blood pressure, and support renal perfusion, especially in patients with hypotension or shock. The choice of fluid (e.g., crystalloids like normal saline or Ringer’s lactate) depends on the patient's volume status and organ function.

In patients who develop hypoxia or respiratory failure, oxygen therapy via nasal cannula, face mask, or non-invasive ventilation may be required. In severe ARDS, mechanical ventilation in an intensive care unit (ICU) becomes necessary. Patients with neurological manifestations such as seizures or altered mental status may require anticonvulsants, neuroprotection, and close monitoring. Hepatic dysfunction and coagulopathies necessitate careful liver function monitoring, avoidance of hepatotoxic drugs, and in some cases, administration of fresh frozen plasma or vitamin K. Critically ill patients often benefit from intensive care monitoring, including regular assessment of vital signs, urine output, arterial blood gases, and organ function markers (liver enzymes, creatinine, lactate levels, etc.). Empirical broad-spectrum antibiotics may be started while awaiting diagnostic confirmation, particularly in regions where co-infections are common. However, antibiotics should be tailored as soon as scrub typhus is confirmed, with doxycycline or azithromycin being the drugs of choice. Importantly, early diagnosis and timely initiation of treatment significantly reduce morbidity and mortality associated with scrub typhus. Clinical suspicion should be high in febrile patients from endemic regions, especially during monsoon and post-monsoon seasons. Identifying an eschar (a dark necrotic lesion at the site of the chigger bite) is pathognomonic but may not be present in all patients. Rapid diagnostic tests, ELISA for IgM antibodies, or PCR-based confirmation should be used wherever available.

In rural and resource-limited areas of India, lack of awareness and limited access to diagnostics often delay treatment. Hence, enhancing clinical training, ensuring availability of essential antibiotics, and establishing fever surveillance programs can strengthen early detection efforts. Public health education campaigns about avoiding exposure to mite-infested areas (e.g., wearing protective clothing, using insect repellents) can further reduce the disease burden (Chrispal *et al.,* 2010).

Recent Advances in Scrub Typhus Diagnosis, Surveillance, and Prevention

Recent advances in scrub typhus management have focused on improving diagnostics, prevention, and surveillance strategies. Rapid point-of-care tests (POCTs), particularly lateral flow immunoassays, are being refined for quicker and more accurate detection of *Orientia tsutsugamushi* antigens or antibodies. Newer versions are designed for multi-antigen detection, increased sensitivity, and integration with mobile apps for digital result tracking (Blacksell *et al.,* 2010).

In vaccine research, recombinant protein vaccines, especially targeting the TSA56 antigen, along with DNA and mRNA-based platforms, are under development to address the antigenic diversity of the pathogen (Murhekar *et al.,* 2017). Genomic tools like whole-genome sequencing (WGS) and multilocus sequence typing (MLST) are aiding in understanding strain variation and guiding region-specific interventions (Paris *et al.,* 2013). PCR technology has also improved, with multiplex PCR and LAMP assays enabling faster, simultaneous detection of multiple febrile illnesses (Chunchanur *et al.,* 2019). Surveillance has expanded through GIS mapping and mobile health (mHealth) platforms, supporting real-time data collection and outbreak response. Additionally, (Rose *et al.,* 2016) AI is being explored for diagnosing eschar lesions via smartphone images and enhancing POCT interpretation. The One Health approach, integrating human, animal, and environmental health data, is being used for vector surveillance and outbreak prediction. Together, these innovations are enhancing early diagnosis, treatment, and control of scrub typhus in endemic regions (Blacksell *et al.,* 2010).

Public Health Initiatives

Inclusion under NVBDCP: The National Vector Borne Disease Control Programme now includes scrub typhus, enhancing surveillance and control (Rose *et al.,* 2016).
GIS Mapping of Hotspots: Geographic Information Systems (GIS) are being used to identify and monitor endemic regions (Rose *et al.,* 2016).
Seroprevalence and Strain Typing Studies: Ongoing efforts are mapping strain diversity and exposure levels in different populations (Murhekar *et al.,* 2017).
Integration with Fever Surveillance: Scrub typhus is being incorporated into broader febrile illness monitoring frameworks for early detection (Rose *et al.,* 2016).

Challenges Faced in Relation to Scrub Typhus

Scrub typhus presents multiple challenges, particularly in endemic and resource-constrained regions of India and Southeast Asia. One of the major diagnostic barriers is its nonspecific clinical presentation, which closely mimics other febrile illnesses such as dengue, malaria, and leptospirosis—frequently resulting in misdiagnosis or delayed treatment. Although the presence of an eschar is considered a hallmark of the disease, it is often absent, overlooked, or difficult to identify, especially in individuals with darker skin or when located in concealed areas of the body. Diagnostic limitations further exacerbate the problem. Primary healthcare centers often lack access to rapid, sensitive, and specific diagnostic tools, leading to delays in confirmation and appropriate therapy. Gold-standard tests such as the Immunofluorescence Assay (IFA) and Polymerase Chain Reaction (PCR) are largely inaccessible in rural and peripheral settings (Blacksell *et al.,* 2010), contributing to diagnostic uncertainty (Mathai *et al.,* 2003).

Figure.1 Chigger (Larva of trombiculid mite)

Figure.2 Scrub typus- *eschar*

From a therapeutic standpoint, the emergence of strains with reduced susceptibility to commonly used antibiotics like doxycycline and azithromycin is an alarming development, underlining the need for continuous antimicrobial resistance surveillance. On the public health front, underreporting and weak disease surveillance systems hamper accurate estimation of the disease burden. Low clinical awareness among healthcare professionals and the general population delays both care-seeking and appropriate management (Sharma *et al.,* 2016). Vector control remains a formidable challenge due to the elusive nature of the chigger mites, which do not respond well to conventional vector control strategies. Additionally, vaccine development is hindered by the high antigenic variability of *Orientia tsutsugamushi*, making it difficult to design a broadly protective vaccine candidate (Vashishtha *et al.,* 2025).

Prevention of Scrub Typhus

Effective prevention of scrub typhus focuses primarily on reducing exposure to infected chigger mites and increasing public and professional awareness, as there is currently no approved vaccine available.

Personal Protective Measures: Individuals living in or traveling to endemic areas should wear long-sleeved shirts, full-length pants, and closed shoes to minimize skin exposure. Tucking pants into socks can prevent mite bites. Avoid sitting, sleeping, or working directly on bare ground or grass, especially in forested or scrubby areas. Applying insect repellents containing DEET, permethrin, or picaridin on exposed skin and clothing provides added protection. Regular bathing and changing clothes after outdoor activity can also help reduce risk. Maintaining hygiene and clearing vegetation around homes, especially in rural and forest-edge settings, helps reduce chigger habitats.

Public Awareness: Education campaigns using posters, brochures, mass media, social media, and community health workers should be carried out in endemic regions. These efforts should focus on symptoms, risk areas, and when to seek care. Conducting workshops and school-based awareness programs further enhances community-level knowledge. Continuing Medical Education (CME) for healthcare professionals improves early recognition and effective management of scrub typhus.

Travel Precautions: Travelers to endemic areas, particularly during the monsoon and post-monsoon months when chigger activity is high, should be advised about protective clothing and repellents. They should also be educated on early symptoms and the importance of timely medical attention.

No Vaccine Available: Due to the absence of a licensed vaccine, preventive strategies remain focused on personal protection, community engagement, early diagnosis, and timely antibiotic therapy to reduce complications and mortality (Vashishtha *et al.,* 2025).

Scrub typhus continues to pose a significant public health challenge in India, particularly in endemic states during the post-monsoon period. The disease is often underdiagnosed due to its nonspecific symptoms, which mimic other febrile illnesses, and the absence of reliable, rapid diagnostic facilities in rural and peripheral healthcare settings. Although effective antibiotics like doxycycline and azithromycin exist, delayed diagnosis and treatment, coupled with emerging resistance, contribute to preventable morbidity and mortality. The lack of a vaccine and the difficulty in controlling vector mites further compound the issue. To effectively address these challenges, a multifaceted strategy is necessary. Increasing clinical awareness through regular training of healthcare providers at all levels can significantly improve early detection and management. Expanding access to reliable diagnostics, such as IFA and PCR, at district and rural levels is essential for timely confirmation. Strengthening surveillance through integration with national fever monitoring programs and using GIS-based hotspot mapping can help track disease trends. Public education initiatives, especially in endemic areas, can promote early care-seeking and preventive behavior. Additionally, investment in research focused on vaccine development, strain diversity, and antimicrobial resistance is crucial. Integrating scrub typhus into national vector-borne disease control programs with adequate resource allocation will enhance early diagnosis, treatment, and long-term disease control.

Author Contributions

Ravikoti Shyamala: Investigation, formal analysis, writing—original draft. K. Sravanthi: Validation, methodology, writing—reviewing. Shalam Nikhat Sheerin:—Formal analysis, writing—review and editing. Sunil Kumar Chavan: Investigation, writing—reviewing. S. Raja: Resources, investigation writing—reviewing. Sekkulandai Kuppuswamy Mohanasundari: Validation, formal analysis, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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