

ZOONOTIC VECTOR-BORNE DISEASES IN INDIA: THE CASE FOR MOVING ONE HEALTH FROM POLICY TO DISTRICT PRACTICE

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ABSTRACT

Japanese encephalitis, scrub typhus, Crimean-Congo haemorrhagic fever, Kyasanur Forest disease and zoonotic Plasmodium knowlesi malaria are vector-borne infections in India that are sustained by animal reservoirs or amplifying hosts. Control programmes that rely on human case management and insecticides therefore act only on the final link of transmission. National data show 10,402 Japanese encephalitis cases and 1,010 deaths between 2018 and 2025, with no sustained fall in case fatality. Crimean-Congo haemorrhagic fever antibodies are present in livestock across 22 states. Kyasanur Forest disease has spread to five Western Ghats states, and scrub typhus transmission is concentrated within human settlements. This letter argues for moving One Health from policy to routine district practice. It proposes five measures: disease-specific animal and vector sentinel indicators reported through the Integrated Health Information Platform; district One Health committees; risk-group mapping; integrated vector management; and One Health training in community medicine, so that medical colleges can act as district hubs.

KEYWORDS: Japanese encephalitis, Scrub typhus, Crimean-Congo haemorrhagic fever, Kyasanur Forest disease, Plasmodium knowlesi.

INTRODUCTION:

Vector-borne diseases (VBDs) account for more than 17% of all infectious diseases and cause over 700,000 deaths every year,¹ and over 80% of the world's population lives at risk of at least one of them.² A distinct subset of these infections in India is zoonotic: their persistence depends on an animal reservoir or amplifying host, not on humans. Japanese encephalitis (JE), scrub typhus, Crimean-Congo haemorrhagic fever (CCHF), Kyasanur Forest disease (KFD) and zoonotic (Plasmodium knowlesi) malaria belong to this group (Table 1). For such diseases, programmes built on human case management and chemical vector control act only on the last link of the transmission chain. The One Health High-Level Expert Panel has defined One Health as an integrated, unifying approach that seeks to sustainably balance and optimise the health of people, animals and ecosystems,³ and the Quadripartite One Health Joint Plan of Action lists the control of endemic zoonotic, neglected tropical and vector-borne diseases as one of its six action tracks.⁴ Through this letter, we wish to argue that these five infections are the clearest case in India for moving One Health from policy statements to routine district-level practice.

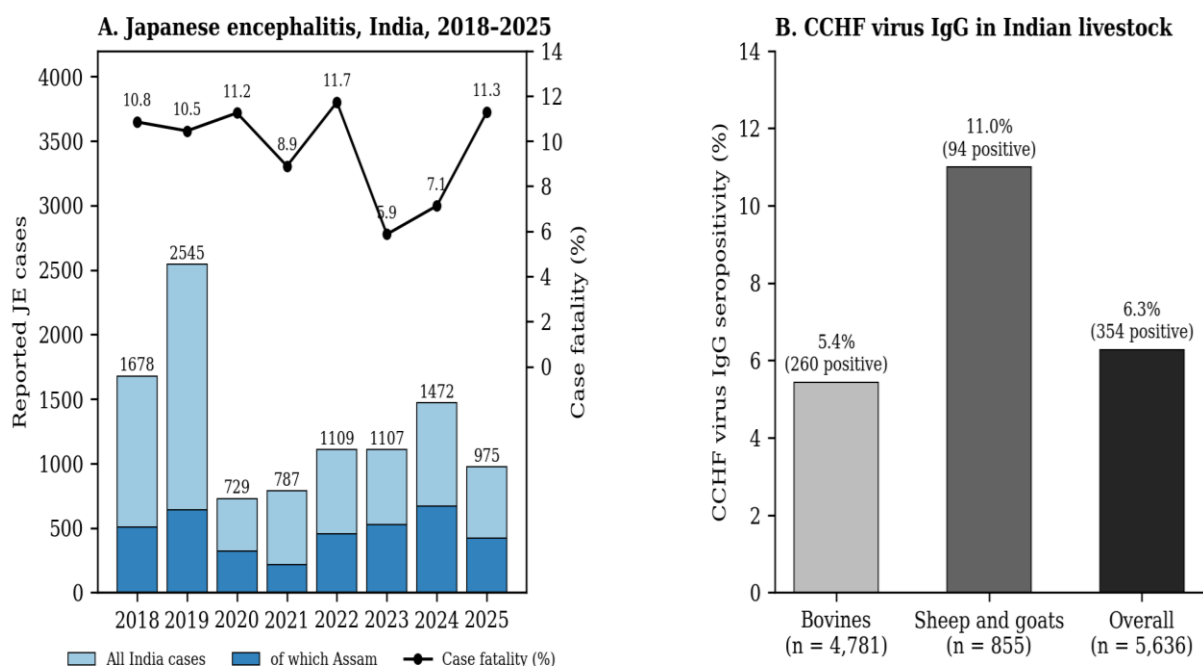
Table 1: Zoonotic vector-borne diseases of public health importance in India: transmission cycle, key national evidence and suggested One Health sentinel indicators (CFR: case fatality rate; UT: union territory)

Disease (agent)	Principal vector	Reservoir / amplifying host	Key Indian evidence	Suggested One Health sentinel
Japanese encephalitis (JE virus)	Culex tritaeniorhynchus and other Cx. vishnui group mosquitoes	Ardeid birds (maintenance); pigs (amplifying); humans and horses dead-end	10,402 cases and 1,010 deaths, 2018–2025; Assam 36% of cases ⁹	Pig seroconversion; JE virus in mosquito pools ^{11,12}
Scrub typhus (Orientia tsutsugamushi)	Larval Leptotrombidium mites (chiggers)	Rodents and shrews	25.3% of acute undifferentiated febrile illness; community seroprevalence 34.2% ¹³	Rodent density and chigger indices within villages ¹⁵

Disease (agent)	Principal vector	Reservoir / amplifying host	Key evidence Indian	Suggested One Health sentinel
Crimean-Congo haemorrhagic fever (CCHF virus)	Hyalomma ticks	Cattle, buffalo, sheep, goats (subclinical)	Livestock IgG 6.3% across 22 states + 1 UT; 34 cases, 17 deaths in Gujarat, 2019 ^{16,17}	Tick positivity on livestock; animal serosurveys ¹⁶
Kyasanur Forest disease (KFD virus)	Haemaphysalis spinigera and other hard ticks	Small mammals (maintenance); langurs and bonnet macaques (amplifying)	Spread to 5 Western Ghats states; Sindhudurg 2016: 130 confirmed, CFR 2.3% ^{18,20}	Event-based reporting of monkey deaths; tick pool testing ¹⁹
Zoonotic malaria (Plasmodium knowlesi)	Forest Anopheles; An. sundaicus in Andaman and Nicobar Islands	Long-tailed and pig-tailed macaques	11.9% of archived Andaman and Nicobar malaria samples positive ²⁴	Molecular speciation of malaria in forest-fringe and island settings ²³

Risk to humans from zoonotic VBDs is best understood through a host–pathogen–vector–environment lens. Spillover occurs only when reservoir density, pathogen prevalence in reservoirs, vector abundance and human exposure align in time and space.⁵ Environmental change repeatedly pushes these factors into alignment. A global analysis of 6,801 ecological assemblages showed that known zoonotic host species, particularly rodents, bats and passerine birds, make up a larger share of local wildlife in agricultural, secondary and urban habitats than in undisturbed ones.⁶ Climate-driven range shifts are also projected to create thousands of new cross-species viral sharing events, concentrated in densely populated parts of Asia.⁷ India’s forest fringes, irrigated rice ecosystems and large backyard livestock economy lie squarely at this interface.

Japanese encephalitis. JE causes an estimated 100,000 clinical cases a year in Asia, with case fatality of up to 30% and permanent sequelae in 30–50% of survivors of encephalitis.⁸ In India, national surveillance recorded 10,402 JE cases and 1,010 deaths between 2018 and 2025; Assam alone contributed 36% of these cases, and the annual case fatality ranged from 5.9% to 11.7% without a sustained decline (Figure 1A).⁹ The principal vector is *Culex tritaeniorhynchus*, which breeds in flooded paddy fields; ardeid birds maintain the virus in an enzootic cycle, pigs act as amplifying hosts, and humans and horses are dead-end hosts.^{8,10} A 2024 scoping review found natural JE virus infection in a much wider range of vertebrates, including bats and perching birds, and called for surveillance that looks beyond pigs and water birds.¹⁰ Serosurveys in Assam have documented substantial JE infection in swine together with modifiable farm-level risk factors,¹¹ and seroconversion in pigs or virus detection in mosquito pools can signal transmission before human cases of acute encephalitis syndrome appear.¹² Human vaccination protects individuals, but it does not interrupt the pig–bird–mosquito cycle; only joint veterinary, entomological and clinical surveillance can do that.



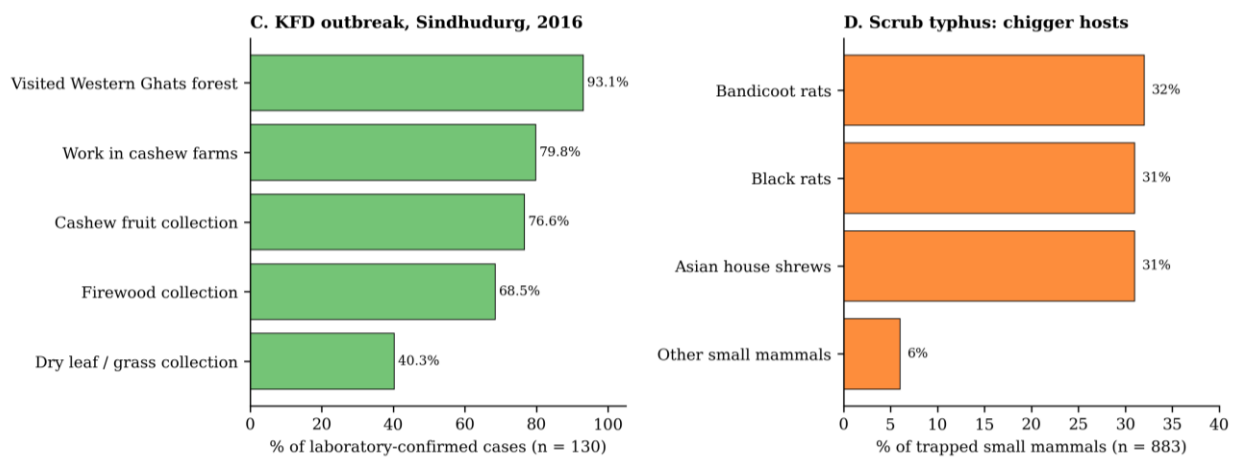


Figure 1: Selected Indian evidence on zoonotic vector-borne diseases. (A) Reported Japanese encephalitis cases in India with the Assam share (bars) and annual case fatality (line), 2018–2025.⁹ (B) Crimean-Congo haemorrhagic fever virus IgG seropositivity in livestock sampled from 22 states and one union territory, 2013–2014.¹⁶ (C) Forest-related activities before illness among 130 laboratory-confirmed Kyasanur Forest disease cases, Sindhudurg, Maharashtra, 2016.²⁰ (D) Composition of 883 small mammals trapped as chigger hosts in South Indian villages, 2022–2023; “other” is the remainder calculated from the published proportions.¹⁵

Scrub typhus. *Orientia tsutsugamushi* is transmitted by the larval stage (chiggers) of trombiculid mites, which feed on small mammals. A systematic review identified 18,781 confirmed cases in India over one decade, with scrub typhus accounting for about a quarter (25.3%) of acute undifferentiated febrile illness in hospital studies and a community seroprevalence of 34.2%.¹³ A later national meta-analysis again confirmed its large contribution to acute febrile illness across Indian states.¹⁴ Recent field work in South Indian villages adds an important One Health insight: among 883 trapped small mammals, bandicoot rats, black rats and Asian house shrews together made up 94% (Figure 1D); *Leptotrombidium imphalum* was the only chigger species found infected (prevalence 3.6%), and host numbers, chigger indices and infection prevalence were all considerably higher inside human settlements than in surrounding fields.¹⁵ This suggests that much human infection is peri-domestic rather than purely occupational, which shifts the prevention focus towards rodent and shrew management, vegetation clearance and household environments.

Crimean-Congo haemorrhagic fever. CCHF virus is transmitted by *Hyalomma* ticks, and infected livestock develop only short-lived, subclinical viraemia while still amplifying transmission. A national serosurvey detected CCHF virus IgG in 354 of 5,636 livestock samples (6.3%) from 22 states and one union territory, with seropositivity twice as high in sheep and goats (11.0%) as in bovines (5.4%) (Figure 1B), indicating that the virus circulates far beyond the districts that have reported human cases.¹⁶ In Gujarat alone, 34 human cases with 17 deaths were confirmed in 2019.¹⁷ Livestock handlers, butchers, veterinarians and healthcare workers are the groups at highest risk. Tick surveillance on livestock and serosurveys in animals are, therefore, the most logical sentinel tools for identifying high-risk areas before human outbreaks, including nosocomial ones.

Kyasanur Forest disease. KFD virus is maintained by *Haemaphysalis spinigera* and other hard ticks in a cycle involving small mammals, while langurs and bonnet macaques amplify the virus and die in large numbers, leaving behind foci of infected ticks. Once confined to a few districts of Karnataka, KFD has now spread along the Western Ghats to Kerala, Goa, Tamil Nadu and Maharashtra.^{18,19} During the 2016 outbreak in Sindhudurg district of Maharashtra, 130 of 488 suspected cases were laboratory-confirmed (case fatality 2.3%), and 93.1% of confirmed patients had visited the forest before illness, mainly for work in cashew plantations, fruit collection or firewood (Figure 1C).²⁰ Ecological modelling has shown that forest loss modifies the relationship between mammalian species richness and KFD risk, with lower species richness associated with more outbreaks in deforested landscapes.²¹ The limitations of the earlier formalin-inactivated vaccine¹⁸ have led to the development of an indigenous adjuvanted inactivated vaccine, whose first-in-human phase I protocol was reviewed by the national Subject Expert Committee in September 2025.²² Until an effective vaccine is widely available, event-based reporting of monkey deaths by forest staff, followed by tick pool testing, remains the earliest warning signal available to health authorities.

Zoonotic malaria. *P. knowlesi* is a parasite of long-tailed and pig-tailed macaques and has become the dominant cause of human malaria in Malaysia, threatening that country’s elimination gains.²³ In India, *P. knowlesi* sequences were found in 53 of 445 (11.9%) archived human malaria samples from the Andaman and Nicobar Islands, and the parasite has since been detected in *Anopheles sundaicus* mosquitoes on Katchal Island, where macaques live close to human habitations.²⁴ As India pursues malaria elimination, a residual reservoir in non-human primates cannot be removed through human case management alone, and molecular species confirmation should be routine in forest-fringe and island settings where macaques and humans interact.

From policy to practice. India has taken important institutional steps, including the multi-ministerial National One Health Mission, anchored at the National Institute of One Health in Nagpur and involving 13 government departments.²⁵ However, qualitative and landscape studies show that collaboration between the human, animal and environmental health sectors still happens mainly during outbreaks or within time-bound research projects, with little routine coordination at

district and sub-district levels.^{26,27} We therefore suggest five practical measures. First, a small set of disease-specific animal and vector sentinel indicators (Table 1) should be reported through the Integrated Health Information Platform alongside human data. Second, district One Health committees, as proposed earlier,²⁸ should bring together the district health officer, animal husbandry officer, forest officer, entomologist and the department of community medicine of the nearest medical college. Third, occupational and peri-domestic risk groups identified above should be mapped and targeted with specific protective measures. Fourth, vector control should follow the integrated vector management principles of the Global Vector Control Response, combining environmental, biological and chemical methods rather than relying on insecticides alone.² Fifth, One Health competencies should be built into undergraduate and postgraduate training in community medicine, so that medical colleges can serve as district hubs for joint investigation and response.

Zoonotic vector-borne diseases in India are not isolated clinical problems but signals of disturbed ecosystems. Their control will depend less on new tools than on whether human, animal and environmental health services can share data and act together before, not after, human cases appear.

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Conflicts of interest

There are no conflicts of interest.

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