

## VETERINARY MEDICINE AS THE FIRST LINE OF DEFENCE AGAINST PANDEMIC EMERGENCE

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### Abstract

More than 60% of emerging infectious diseases originate in animals, yet veterinary medicine remains marginalised in pandemic preparedness planning, particularly in India. This review examines what the outbreak record reveals regarding veterinary surveillance, analyses why One Health integration has stalled in India, and proposes actionable institutional reforms. Early veterinary involvement consistently accelerated outbreak containment. India's ratio of one veterinarian per 7,000 livestock animals is the lowest among G20 nations; less than 3% of the national health budget reaches veterinary epidemiology; and Karnataka's forest-farm boundary a known Nipah-risk zone has no routine surveillance programme. Integrating veterinary epidemiology into India's pandemic architecture is both practically necessary and economically compelling. Concrete reforms with 2030 milestones are proposed, anchored in existing institutions.

**Keywords:** One Health; zoonotic diseases; veterinary epidemiology; pandemic prevention; spillover surveillance; India; veterinary workforce capacity; antimicrobial resistance; wildlife health; biosecurity

### Introduction

Every major disease outbreak of this century Nipah, SARS-CoV-1, H5N1, Ebola, SARS-CoV-2 began in animals before reaching human populations (Jones et al., 2008; Wolfe et al., 2007). More than 60% of emerging infectious diseases are zoonotic in origin, yet the professionals trained in animal health remain largely absent from pandemic preparedness planning. The 2022 WHO/FAO/OIE/UNEP One Health Joint Plan of Action names integrated veterinary surveillance as a cornerstone of global health security (WHO, FAO, OIE, and UNEP, 2022), but significant gaps persist between policy and practice. India exemplifies this challenge: with 535 million livestock, extraordinary wildlife diversity, and accelerating deforestation, it sits in high-risk territory for zoonotic emergence (Gibb et al., 2020), yet less than 3% of its national health budget reaches veterinary epidemiology (India MoHFW, 2021).

This review examines what the outbreak record reveals regarding veterinary involvement in containment; diagnoses why One Health integration has stalled in India; and proposes specific, costed reforms anchored in existing institutions—KVAFSU, ICMR, and the National One Health Strategy Framework (India MoHFW, 2021).

### Methods

A narrative synthesis was conducted, drawing on structured searches of PubMed, Web of Science, and Google Scholar (1990–March 2025). Four outbreak case studies were analysed: Nipah virus (2001–2023), H5N1 avian influenza (2003–2024), West Africa Ebola (2014–2016), and SARS-CoV-2. Comparative surveillance data were drawn from the WOAHA/FAO Global Veterinary Workforce Study (WOAHA and FAO, 2022) for six countries. Economic projections apply published return-on-investment figures to India-specific outbreak data (Government of Kerala, 2019).

### 3. Ecological and Anthropogenic Drivers of Pandemic Emergence

Pandemic emergence is not random. Deforestation pushes wildlife closer to farms, industrial livestock farming amplifies viral transmission, and the wildlife trade moves pathogens across continents (Hansen et al., 2013; Graham et al., 2008; Plowright et al., 2021). Climate change is expanding vector ranges (Carlson et al., 2022). Bats are particularly significant reservoirs: more than 60 bat-associated viruses carry zoonotic potential (Calisher et al., 2006), and spillover typically involves an intermediate amplifying host—pigs in Nipah, civets in SARS-CoV-1 and monitoring these hosts

is precisely what veterinary teams are trained to accomplish.

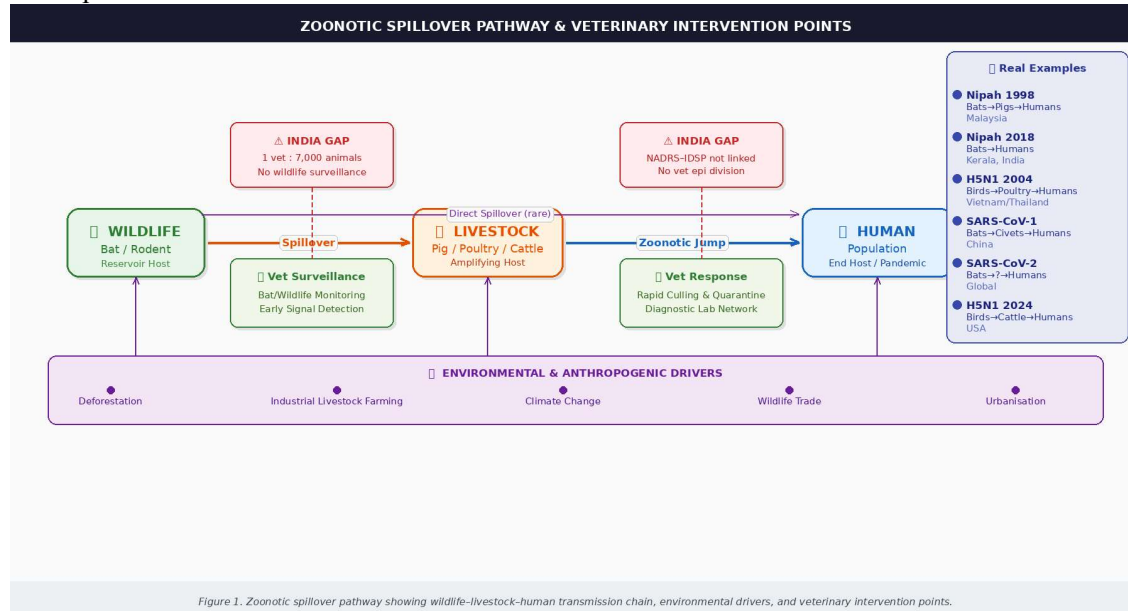


Figure 1. Zoonotic spillover pathway: wildlife reservoir to human pandemic, with environmental drivers and veterinary intervention points. Red boxes indicate India's current surveillance gaps.

#### 4. Evidence from Outbreak Case Studies

##### 4.1 Nipah Virus, Kerala and West Bengal (2001–2023)

The 2018 Kerala Nipah outbreak killed 17 of 19 confirmed cases (89.5% fatality rate), yet was contained within 45 days without sustained community spread. Veterinary field officers triggered the human health response by identifying unusual bat colony mortality near the index farm (Arunkumar et al., 2019). By contrast, the 2001 Siliguri outbreak, lacking equivalent veterinary early-warning capacity, spread through three generations of hospital transmission before it was brought under control. Kerala's rapid containment of Nipah re-emergences in 2021 and 2023 (WHO, 2021; Chandran et al., 2024) confirms the replicability of this surveillance model.

##### 4.2 H5N1 Avian Influenza and SARS-CoV-2

Every successfully contained H5N1 outbreak—Vietnam 2004, Thailand 2004, Egypt 2006—placed veterinary teams at the centre of operations (Swayne et al., 2013). The 2024 emergence of H5N1 in North American dairy cattle was detected solely through veterinary diagnostic laboratories processing routine milk samples; human surveillance systems were not

**Table 1. Comparative veterinary surveillance capacity (Source: WOA/FAO 2022)**

configured to identify this pathogen in animals. SARS-CoV-2 illustrates the cost of delayed detection: projected global economic losses were estimated at \$12–16 trillion (McKibbin and Fernando, 2021).

#### 5. India's Vulnerability Profile and Institutional Gaps

India's zoonotic risk profile ranks among the highest of any G20 nation. Its 535-million-animal livestock population is the world's largest; wildlife biodiversity includes 14 bat families and 12 rodent-borne viral lineages flagged as zoonotic concerns. Karnataka alone lost 1,548 km<sup>2</sup> of forest cover between 2015 and 2023, compressing wildlife-livestock contact zones in corridors identified as Nipah-risk areas (KVAFSU, 2023; Vora et al., 2022). Yet surveillance infrastructure remains limited. At one veterinarian per 7,000 livestock animals, India's ratio is far below Brazil (1:1,200) or the EU average (1:800) (WOAH and FAO, 2022). The National Centre for Disease Control (NCDC) has no dedicated veterinary epidemiology division, and animal and human disease databases are maintained on non-interoperable platforms with no real-time linkage (India MoHFW, 2021).

Country	Veterinarian-to-Livestock Ratio	One Health Integration Status	Dedicated Veterinary Epidemiology Budget
United States	1:500	CDC-USDA joint operations	>6% of health budget
Canada	1:450	Fully integrated	>5% of health budget
Australia	1:700	Integrated (2018)	~5% of health budget
Brazil	1:1,200	Partial integration	~3% of health budget
China	1:2,000	Post-COVID acceleration	~4% of health budget
Mexico	1:3,200	Emerging integration	~2% of health budget
India	1:7,000	Pilot stage (2021 NOHS)	<3% of health budget

**Note:** India demonstrates the lowest veterinarian-to-livestock ratio and smallest dedicated budget allocation among all G20 comparators.

## 6. Barriers to One Health Integration

The barriers to One Health integration are institutional and political rather than scientific. Four principal obstacles are evident. First, human and animal health sit under separate ministries with separate budgets, creating coordination friction that costs critical time during rapid outbreaks. Second, India graduates approximately 3,200 veterinarians annually, but fewer than 40 receive meaningful epidemiology training; KVAFSU lacks a postgraduate programme in veterinary epidemiology or wildlife health. Third, the National Animal Disease Reporting System (NADRS) and Integrated Disease Surveillance Programme (IDSP) are non-interoperable, with no automated link between animal and human disease signals. Fourth, prevention investments face political barriers: the outbreak that does not occur generates no electoral visibility.

## 7. A Structural Reform Agenda for India: 2025–2030

### 7.1 Legislative and Institutional Reforms

- Amend the Epidemic Diseases Act (1897) to include animal disease events as triggers for national health emergency protocols, with veterinary epidemiologists guaranteed statutory seats in Emergency Operations Centres.
- Establish a National One Health Coordination Unit under joint Ministry of Health and Agriculture authority, with a

minimum 5% of national health security allocation ring-fenced by legislation.

- Achieve real-time NADRS–IDSP data integration through a shared API by December 2027.

### 7.2 Workforce Development

- Create 40 dedicated veterinary epidemiology positions within state health directorates by 2030, prioritising Karnataka, Kerala, Assam, and Maharashtra.
- Launch an MSc in Veterinary Epidemiology and Wildlife Health at KVAFSU, in collaboration with FAO and WHO, with the first cohort entering in 2026.

### 7.3 Surveillance Infrastructure

- Establish a Karnataka Wildlife Health Sentinel Programme modelled on Kerala's Nipah virus bat surveillance network: quarterly sampling of Pteropus and Rhinolophus colonies at 15 priority sites along the Western Ghats.
- Deploy portable metagenomic sequencing units to a minimum of 10 State Wildlife Health Units, with a national bioinformatics support hub at KVAFSU-Bengaluru.

## 8. The Economic Case

Morens and Fauci (2020) estimate pandemic prevention returns at \$500–\$700 saved per \$1 invested. The 2018 Kerala Nipah containment cost approximately Rs. 50 crore

(Government of Kerala, 2019); had it escalated to sustained community transmission at a comparable scale, conservative modelling places potential losses above Rs. 2.8 lakh crore. The full reform package in Section 7 totals approximately Rs. 180 crore over five years—0.003% of India's annual GDP—a compelling investment by any cost-benefit standard.

## 9. Conclusion

Veterinary surveillance is a uniquely critical input in pandemic prevention. Cross-species training, field presence in wildlife and livestock environments, and diagnostic

infrastructure cannot be improvised after an outbreak begins. India's convergence of risk factors—livestock density, wildlife diversity, deforestation pace, and veterinary workforce gap—is matched by few other G20 nations. The 2021 National One Health Strategy Framework provides a legitimate starting point (India MoHFW, 2021), but what has been absent is an implementation plan with sufficient specificity: named institutions, costed components, and realistic timelines. The reforms outlined here require neither new institutions nor international funding, and could substantially enhance India's pandemic preparedness within five years.

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