Community Zoonotic Case Definitions in Rural Cambodia: Syndromic Knowledge, Reporting Barriers, and Design Considerations for a Community-Based Early Warning System

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Summary
This paper presents findings from a qualitative study conducted in two provinces of Cambodia — Battambang and Stung Treng — aimed at documenting how rural communities perceive, identify, and respond to zoonotic disease signals. Using a Human-Centered Design (HCD) approach, the study maps the gap between technical case definitions and community-level knowledge, identifies the economic and social barriers that prevent early reporting, and proposes a risk threshold framework to guide the design of a functional One Health early warning system. The findings suggest that limited success of surveillance in this context is not primarily a technical problem, but a design problem — one that requires rethinking who the system is built for, and what it offers to the people closest to disease signals.

Introduction
The AfriCam project (Preventing and Monitoring Zoonotic Disease Emergence in Africa and Cambodia) is a multidisciplinary initiative investigating zoonotic risks at the intersection of hydrology, climate, and environment in Cambodia. Its broader objective is to strengthen existing surveillance programmes into an integrated One Health (OH) surveillance system capable of early detection (1). The project operates across two provinces with distinct socio-ecological profiles, and the work described here forms part of Component 3, focused on the implementation of surveillance and early detection strategies.

Cambodia sits at a particularly complex interface between human, animal, and environmental health. The country's rural landscape is shaped by smallholder agriculture, backyard poultry farming, free-ranging livestock, and a strong cultural tradition of consuming wild animals and bush meat. These conditions, combined with porous borders, climate-driven flooding events, and the heavy use of agricultural chemicals, create an environment where zoonotic spillover events are both plausible and difficult to detect early (2).

The two study provinces present contrasting but complementary profiles. Battambang is heavily oriented toward commercial livestock and rice production, with a relatively active veterinary presence and a community that has some historical memory of disease events, including a past H5N1 outbreak in a neighbouring village. Stung Treng is more remote, with smaller livestock holdings, a more passive volunteer surveillance system that has largely fallen inactive due to low local demand and insufficient government support, and a primary focus on wildlife conservation. Despite these differences, both provinces share a common challenge: formal surveillance structures exist, but early detection of zoonotic events is consistently delayed.

These delays are not primarily explained by a lack of protocols. Rapid Response Teams exist. Health centres operate weekly reporting systems. Village Animal Health Workers (VAHWs) are trained. The gap lies elsewhere — in how communities understand disease, in what reporting costs them economically, and in whether the system offers them anything in return. Addressing this gap requires starting from the community's own logic, not from the technical definition of zoonosis. Communities in both provinces have no specific Khmer term for zoonosis. Disease events that move between animals and humans are described narratively — as sicknesses that "jump" — without a conceptual category that would make them identifiable as something requiring specific action. Infectious outbreaks are frequently attributed to environmental causes — pesticide runoff, industrial pollution, unusual weather — rather than to pathogens. This environmental bias is not ignorance; it reflects lived experience, where chemical contamination and polluted waterways are visible, immediate, and recurring threats, while viral pathogens remain invisible and abstract (3).

Materials and Methods

Fieldwork was conducted between September and October 2025 across four villages in Ek Phnom district (Battambang) and Thala Borivat district (Stung Treng). Site selection followed criteria developed jointly with CIRAD and IRD, prioritising areas with high potential for disease emergence at the wildlife-livestock-human interface, high reliance on animal or forest products, and a range of economic activities and risk profiles to ensure both high-risk and lower-risk communities were represented.

The study used a Human-Centered Design (HCD) framework, which prioritises understanding the motivations, constraints, and decision-making processes of end users before proposing any intervention. This approach was chosen precisely because previous surveillance efforts in similar contexts had struggled to produce systems that communities actually used. Rather than starting from technical syndromic definitions and testing community awareness of them, the study started from the community's own language, categories, and experience.

Thirty-six participants were recruited across three stakeholder tiers: local knowledge holders (small-scale farmers, village and commune chiefs, consumers, rangers), animal health actors (VAHWs, government veterinary staff, commercial farmers, animal feed suppliers), and human health professionals (health centre staff, Rapid Response Team members, private clinic workers). This diversity was deliberate — understanding the informal actors in the system, such as feed suppliers and private pharmacies, proved as important as understanding the formal ones.

Data were collected through in-depth interviews, focus group discussions, mini-workshops, and direct observations in markets, farms, homes, and community spaces (3). Card-sorting exercises using images of animal species were used to elicit responses about animal contact and disease recognition without requiring participants to engage with abstract terminology. Observations were conducted in parallel with interviews to identify the frequent disconnect between what people say they do and what they actually do when an animal falls ill. Data were analysed through affinity mapping and thematic clustering within digital collaboration tools.

Results

Economic barriers to reporting

The most consistent finding across both provinces is that livestock functions not only as a production asset but as a savings account. For families with no access to formal credit or insurance, animals represent an emergency fund — the thing you sell when a child is sick or a school fee is due. Household-level reporting of animal health event to authorities is therefore perceived as triggering immediate and total financial loss, through mandatory culling, farm lockdowns and market temporarily closure, with no compensation. This makes silence the economically rational response.

The consequence is a well-established informal pathway: at the first signs of illness, farmers slaughter and sell symptomatic animals to middlemen before authorities can intervene or consume sick or already dead animals. They treat poultry with human over-the-counter medicines — paracetamol, amoxicillin — purchased from local pharmacies, because involving a VAHW feels unnecessary and potentially dangerous. This informal treatment pathway is largely invisible to both animal and human health surveillance systems, and creates conditions where a sick animal can move through a market chain before anyone with formal training has seen it.

Mass mortality in poultry is perceived as normal. Farmers across both provinces described seasonal die-offs in April and during the September-October weather transition as expected events, linked to heat stress or rain, not to pathogens. Without a reference point that distinguishes this seasonal norm from an infectious outbreak, the threshold for seeking external help remains very high. In practice, VAHWs are rarely contacted until mortality is severe and already widespread.

Risk threshold framework

The study mapped community responses to disease signals into a four-level sensitivity framework (see Figure 1), separately for human and animal health, and validated across both provinces despite their different surveillance contexts.

At the low-sensitivity level, common signs such as runny noses, mild lethargy, or light respiratory sounds in poultry are treated with home remedies or human medicines purchased without prescription. No report is made, no concern is expressed, and the event is absorbed as background noise.

At the medium-sensitivity level, more specific signals appear — twisted necks in poultry, drooping wings, a handful of deaths, or early news of outbreaks in neighbouring areas — but the response remains private. Farmers may secretly slaughter, sell or consume sick animals, or bury carcasses without reporting. Social

signals also appear at this level: community chatter at market stalls, and notably, the sight of researchers or officials in protective equipment collecting samples, which functions as a more powerful alarm trigger than any clinical sign.

High-sensitivity triggers are defined by specific mortality thresholds — ten to twenty birds per household dying simultaneously, or thirty to a hundred or more dying across a village within a short period — combined with social amplifiers such as viral content on TikTok and Facebook, warnings from village chiefs, or word-of-mouth about confirmed cases in nearby areas. At this level, consumers begin avoiding market poultry showing visible signs — purple skin, bloody eyes, faecal residue — and some farmers begin contacting authorities, though many still first attempt secret slaughter.

Full outbreak-level response, including laboratory testing and government intervention, only occurs after mass mortality or confirmed human cases. By this point, the window for early detection has long passed.

For human health, the same escalation logic applies. H5N1 generates concern only when an outbreak is already confirmed nearby. During COVID-19, the most operationally useful signal documented was sudden anosmia — the loss of smell — which communities adopted as a reliable self-diagnostic marker in the complete absence of formal testing capacity. This is worth noting: communities developed their own functional case definition under pressure, and it worked.

Positive deviances
Several existing practices demonstrate that behaviour change related to reporting is possible under the right conditions, and offer concrete leverage points for system design.

Commercial farmers in both provinces conduct daily health checks, apply strict biosecurity, and self-research symptoms through YouTube and TikTok, not because they are better trained but because their economic model depends on early detection. They represent a practical model that neighbouring small-scale farmers respond to more readily than external officials.

Animal feed suppliers are perhaps the most underutilised resource in the current system. They provide vaccines, medicine, and feed on credit after a loss, functioning simultaneously as a bank and an informal veterinarian. Farmers trust them and visit them regularly, making them a natural surveillance node that currently operates entirely outside the formal reporting chain.

The Malaria Information System (MIS) demonstrates that digital reporting tools work in this context when they are simplified and institutionally supported. Village malaria workers use phones or tablets to record and report cases in real time — a model that has proven effective for an aging, volunteer-based workforce when given sufficient training and sustained government backing.

Village and commune chiefs emerged across both provinces as the most effective communicators for health measures during COVID-19. Villagers described them as "parents" — people whose instructions carry both authority and trust. Health messages and surveillance requests that came through chiefs were accepted; those that came through top-down mandates were more often ignored or resisted.

Discussion
The picture that emerges from this study is not of communities that are unwilling to participate in surveillance. It is of communities that have made rational calculations about what surveillance costs them and what it offers in return, and found the balance unfavourable. Addressing this requires more than simplifying case definitions or training more VAHWs. It requires redesigning the economic logic of reporting.

A sustainable EWS in this context needs at minimum three things that are currently absent. First, financial safety nets — some form of compensation or credit mechanism for families who report and lose animals to culling — to make reporting a viable option rather than a punishment. Second, accountability loops — systematic return of test results and follow-up information to the communities that provided samples — to demonstrate that the system works for them, not only for provincial or national health statistics. Third, formal integration of informal actors — feed suppliers, private pharmacies, commercial farmers — into surveillance networks, with appropriate training and clear reporting pathways.

The risk threshold framework documented here offers a starting point for co-designing syndromic case definitions that are grounded in local experience and expressed in local language. Simplified definitions such as "fever plus twisted neck plus more than ten dead birds in one day" are more actionable for a farmer or village chief than a clinical description of Newcastle Disease or H5N1. These community case definitions need to be

validated and refined through co-construction workshops involving both communities and technical actors, and integrated into digital reporting tools that are adapted to the literacy and connectivity constraints of rural Cambodia (4, 5).

The broader lesson may be simple: surveillance systems that are designed around what health authorities need to know, without considering what communities need to be safe, will consistently underperform. Starting from community logic is not a concession — it is a precondition for a system that actually detects events early enough to matter.

Sensitivity level	Key signals	Social / environmental triggers	Community response
Low	Runny nose, mild rattling breath	Seasonal weather transition	Home remedies, no report
Medium	Twisted necks, drooping wings, scattered deaths	Community rumour, officials with PPE visible	Secret slaughter or sale, no formal alert
High	10–20 birds/household dying simultaneously	Viral social media, warning from the village chief	Avoidance behaviour, possible alert to the chief
Outbreak	Mass mortality, confirmed human cases	Lab confirmation, government notification	Market closure, testing, government intervention

Note: For human H5N1, the trigger escalation follows the same pattern. For COVID-19, sudden anosmia (loss of smell) was the primary community-level diagnostic signal used across both provinces in the absence of formal testing.

Community risk threshold framework for zoonotic disease signals — poultry and human health (Battambang and Stung Treng, Cambodia, 2025)

Keywords: zoonosis, community surveillance, Human-Centered Design, early warning system, Cambodia.

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