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Community-Based Surveillance Information Pathway in Decentralized One Health Systems in Uganda

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Research Article

Keywords: community-based surveillance, epidemic intelligence, One Health, community health workers, surveillance systems, zoonoses, Uganda, event-based surveillance

Posted Date: November 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11479112/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Community-based surveillance is increasingly used to extend One Health surveillance into rural settings where formal systems have limited reach. However, evidence often emphasizes the number of reports or the performance of community-based actors, while less is known about the information pathway through which community observations are recorded, classified, communicated, and linked to wider surveillance processes. This gap is especially important in decentralized systems, where information generated at community level must move across multiple actors and surveillance functions before it can contribute to wider public health action.

Objective

The objective is to examine how community-generated human, animal, and wildlife observations move through a decentralized One Health surveillance system in Uganda, and to assess how far these information pathways can be traced from observation and recording to notification and potential downstream surveillance action.

Methods

We conducted a retrospective empirical analysis of COHRIE-Uganda community surveillance records, complemented by program documentation on reporting and implementation processes. The dataset contained 25,646 records from four conservation landscapes, including 24,868 routine Logbook/Surveillance records and 778 Detection/Outbreak records. We described the domains and characteristics of observations, examined notification following abnormal livestock deaths, identified reported notification recipients, assessed Detection/Outbreak classification, and evaluated data completeness and information traceability using available household, geographic, temporal, and event-level fields.

Conclusions

The records captured observations across human, livestock, and wildlife domains, including 3,455 reports of ticks in livestock, 1,906 livestock abortions, 2,541 abnormal livestock deaths, 5,641 wild animals in gardens or homes, 2,066 contacts with wild animals elsewhere and 1,115 wildlife attacks. Among 6,170, 5,958 had records with a valid notification response following an abnormal livestock death; 3,220 (54%) indicated that someone had been notified. Reported recipients included local leaders and veterinary and animal-health personnel. The Detection/Outbreak branch contained 778 records; 273 (35.0%) lacked a populated detection-type field. Household, geographic, and event-level fields provided a basis for tracing observations, but incomplete identifiers, classification fields, and notification documentation limited the ability to establish continuity beyond initial reporting. Community surveillance generated a broad upstream layer of decentralized One Health information and documented pathways from community observation to local and sectoral notification. Its contribution to epidemic intelligence

cannot be inferred from reporting volume or notification alone. It depends on whether observations can be consistently classified, linked to subsequent verification and response, and fed back into wider surveillance processes. Strengthening persistent event identifiers, cross-sector linkage and downstream documentation could improve the traceability and operational value of community-generated surveillance information.

Background

Early recognition of unusual health events is central to epidemic preparedness and response. Conventional surveillance systems may have limited reach in rural and geographically dispersed populations, particularly where people, livestock and wildlife interact closely. Community-based surveillance can extend surveillance into these settings by enabling community members or trained community-based actors to recognize and communicate unusual events involving people, animals and the environment [1, 2].

Detection alone, however, does not constitute epidemic intelligence. For a community observation to contribute to public-health decision-making, it must be captured as usable information and communicated through appropriate surveillance channels. Its subsequent value depends on whether it can be received, interpreted, verified, and incorporated into wider surveillance and response processes. This is particularly relevant to One Health surveillance, where information may move between community structures, local government, veterinary services, public-health authorities, conservation actors and other institutions [3]. Uganda-specific analyses have likewise identified coordination and information sharing across sectors as important conditions for operationalizing One Health [6].

The Collaborative One Health Research Initiative on Epidemics (COHRIE-Uganda) established a community-based surveillance component involving Community One Health Volunteers (COHVs) across conservation landscapes in Uganda [4]. The program was designed to strengthen surveillance at human-animal-wildlife interfaces in the context of zoonotic disease prevention and preparedness.

Program-level surveillance outputs have previously been reported through COHRIE technical and general reports [9]. Related COHRIE work has also examined gendered exposure pathways [5]. The present study addresses a different analytical question by examining the underlying community surveillance records to understand how observations are captured and communicated within the surveillance system. It is framed as an empirical health-systems and implementation analysis of the information pathway through which community observations may become usable One Health surveillance information.

We conceptualized community-based surveillance as a decentralized information-generating component of One Health surveillance. Decentralization was treated as an organizational feature of the information pathway: observations are generated close to households and may be received, interpreted, and escalated by local actors before they reach formal district or national structures. The study examined the pathway from community observation to surveillance signal and notification, and assessed the extent to which information could be traced through the available surveillance records.

The study question was: How are community-generated human, animal, and wildlife observations captured and communicated within a decentralized One Health surveillance system in Uganda, and how traceable are these information pathways within the available surveillance records? The analysis therefore follows the pathway from observation and reporting to notification and potential linkage with verification, response, and feedback, without treating any of these records as evidence of program effectiveness or population-level impact.

Methods

Study design and setting

We conducted a retrospective empirical analysis of community surveillance records generated through COHRIE-Uganda. The analysis focused on the community surveillance component represented in the available logbook dataset. It was complemented by program documentation describing household surveillance, COHV supervision, data collection, reporting, and communication processes. COHRIE-Uganda operates across conservation landscapes where communities interact with livestock, wildlife, and surrounding ecosystems. The community surveillance dataset analyzed in this study contained records from Murchison Falls, Bwindi-Mgahinga, Queen Elizabeth, and Lake Mburo-Nakivale conservation areas. The broader COHRIE program investigates priority zoonotic diseases including Rift Valley fever, Crimean-Congo haemorrhagic fever and brucellosis [4].

Community One Health Volunteer surveillance

COHVs formed the community-facing component of the surveillance system. Their activities included household engagement, collection of surveillance information, identification of unusual health-related observations, and communication of relevant information. Household surveillance was structured around repeated visits and household-level records. Implementation activities included household mapping and assignment of household identifiers to facilitate longitudinal surveillance and reconciliation. Data collection incorporated electronic tools alongside paper-based and operational records.

Data sources

The principal source was the COHRIE community surveillance logbook export containing 25,646 records and 576 variables. The dataset comprised two reporting branches: 24,868 Logbook/Surveillance records and 778 Detection/Outbreak records. The routine surveillance branch included household and visit information together with observations concerning livestock health, ticks, abortions, abnormal livestock deaths, wildlife contact, wildlife attacks, veterinary service seeking, and notification. The Detection/Outbreak branch captured more detailed information on unusual human and livestock events, including symptoms or signs, affected populations, suspected diseases, vector observations, location,

and, in some records, photographs. Program reports and operational documentation were reviewed to provide context on household mapping, COHV supervision, electronic data collection and communication arrangements. The current raw export was retained as the analytical dataset. Previously reported program totals were used only for contextual comparison because they were derived from earlier data extracts and reporting processes.

Analytical framework

The analysis conceptualized community surveillance as a pathway from observation to signal to information. An observation was defined as information recorded during a surveillance encounter concerning a human, animal, wildlife, or related condition. A potential signal was an observation indicating an unusual or potentially important event according to the surveillance instrument. Notification referred to recorded communication of such an observation or event to another person or institution. This distinction is consistent with event-based surveillance approaches that separate the recognition and communication of signals from subsequent verification [8]. Decentralization was examined through the location of information generation, the local and sectoral actors recorded as recipients, and the extent to which information could be linked across organizational levels. This distinction allowed routine household observations to be separated from explicit event reporting and from subsequent verification. A household visit was therefore not considered a signal in itself, and a reported notification was not considered evidence of a confirmed event.

Data analysis

Descriptive analyses characterized the temporal and geographical distribution of routine surveillance records and the occurrence of selected human, livestock and wildlife observations. The analysis also examined notification following abnormal livestock deaths, reported notification recipients and the classification of Detection/Outbreak records. Percentages were calculated using valid responses for individual variables where missing or non-applicable responses were substantial. Counts of observations were not interpreted as counts of confirmed disease events. Information traceability was assessed using available household identifiers, COHV identifiers, dates, geographical information, event characteristics, notification fields, and the relationship between routine and Detection/Outbreak records. Program documentation was used to interpret the operational context of these records.

Data quality

Data completeness and consistency were assessed for key surveillance variables. Particular attention was given to missing classification fields, household identifiers, and differences between routine and Detection/Outbreak records. The current raw export contained 24,868 routine records dated 2023–2025, whereas an earlier funder-facing report summarized 24,108 records for the same period. Because the two figures originated from different data versions and extraction processes, the present analysis used the raw export as its primary dataset and did not combine figures across versions.

Ethics

The study used program-generated surveillance information collected under the COHRIE-Uganda research framework. The parent COHRIE program received ethical and regulatory approvals from the relevant Ugandan authorities, including the UVRI Research Ethics Committee and the Uganda National Council for Science and Technology. The present analysis was conducted within the COHRIE-Uganda data-governance framework. The dataset was handled as restricted program data because some records contain potentially identifiable household or location information.

Results

3.1 Community surveillance records

The analyzed dataset contained 25,646 records, comprising 24,868 routine Logbook/Surveillance records and 778 Detection/Outbreak records. Routine records were distributed across four conservation landscapes. Murchison Falls contributed 7,912 records (31.8%), Bwindi-Mgahinga 7,159 (28.8%), Queen Elizabeth 6,517 (26.2%), and Lake Mburo-Nakivale 3,280 (13.2%). The routine records spanned 2022–2025. The largest numbers were recorded in 2025 (10,925), 2024 (7,311), and followed by 2023 (6,632).

3.2 Human, livestock and wildlife observations

The routine surveillance instrument captured observations across multiple One Health domains. Ticks were reported in 3,455 records, livestock abortions in 1,906, and abnormal livestock deaths in 2,541. Wild animals were reported in gardens or homes in 5,641 records, contact with wild animals elsewhere in 2,066, and wildlife attacks in 1,115. These observations demonstrate the breadth of information captured through household surveillance across human-animal-wildlife interfaces. They represent reported observations recorded through the surveillance instrument and do not constitute confirmed disease events. Figure 1 presents the relative volume of the selected observation categories.

Counts represent records with a reported observation in the relevant surveillance field. They are not counts of confirmed disease events.

Notification of abnormal livestock deaths

Among 6,170 routine records with a valid response to the question concerning notification following an abnormal livestock death, 5,958 had a notification response whereby 3,220 (54%) indicated that someone had been notified and 2,738 (46%) indicated that no notification had occurred. Reported recipients included local leaders (1,103 records), veterinary officers (328), other recipients (191), animal health workers (193), veterinary assistants (164), and veterinary technicians (73). Some records identified more than one recipient. These findings demonstrate a documented transition from community observation to communication with local or sectoral actors, illustrating the decentralized reception and escalation of surveillance information. Table 1 summarizes the number of records for

each reported notification recipient, while Fig. 2 shows their distribution. The records do not establish whether individual notifications were subsequently verified or acted upon.

Table 1
Reported notification recipients following abnormal livestock deaths

Reported recipient	Records
Local leader	1,103
Veterinary officer	328
Other recipient	191
Animal health worker	193
Veterinary assistant	164
Veterinary technician	73

Counts represent recorded notification recipients among routine records with a reported notification. Recipient fields were not mutually exclusive.

Decentralized information flow

The records showed that surveillance information was generated at the household and community level and then communicated to local or sectoral actors. Among valid responses after abnormal livestock deaths, 3,220 records (54.0%) indicated that someone had been notified. The documented recipients included local leaders, veterinary officers, animal-health workers, veterinary assistants and veterinary technicians. These findings show that the information pathway was organized around local reception and escalation rather than direct transmission from households to a central surveillance office. The available records do not show whether this distributed pathway led to verification, response, or feedback.

Detection and outbreak reporting

The Detection/Outbreak branch contained 778 records. Of these, 254 were classified as human and 251 as livestock, while 273 did not have a populated detection-type field. The branch captured more detailed information on unusual human and livestock events, including symptoms or signs, affected populations, onset, suspected diseases, vector observations, and location. The presence of event-level fields provided a mechanism for documenting observations that progressed beyond routine household surveillance. The absence of a populated detection-type field in 273 records indicates some inconsistency in classification within the dataset. Because other information was present in some of these records, the missing classification could not be assumed to indicate absence of an event.

Information continuity within the surveillance system

The surveillance records contained household, geographical, and visit-level information that supported identification of the context in which observations were generated. Household mapping activities also

introduced unique household identifiers intended to support longitudinal surveillance and reconciliation. Operational documentation nevertheless identified practical challenges affecting continuity of household records, including duplicate household lists, household mobility, inconsistent identifiers, and variation in household coverage. These issues are relevant to the ability to link observations across successive surveillance encounters. The available dataset provided evidence of observation, recording, and notification, but did not consistently provide a linked record through which individual community observations could be followed to subsequent verification or response. Consequently, the contribution of individual community notifications to downstream surveillance action could not be established from the logbook alone. Figure 3 summarizes the conceptual information pathway examined in this study.

The pathway illustrates the conceptual sequence from community observation through recording, classification and local notification to verification, integration, response and feedback. The analyzed records provide evidence mainly for the upstream stages. The downstream stages require linkage with records beyond the community logbook.

Figure 4 presents the decentralized One Health information architecture represented by the surveillance pathway.

The architecture illustrates decentralization as an organizational feature of the surveillance system. Information is generated close to households, received and escalated through local and district actors, linked to national One Health structures, and returned through feedback and coordination pathways. This conceptual representation is interpretive and is not a measure of system performance or impact. Table 2 summarizes the principal data components and information-pathway findings.

Table 2
Community surveillance data sources and information-pathway findings

Data component or pathway stage	Evidence in the analyzed export	Interpretation for the surveillance pathway
Routine Logbook/Surveillance records	24,868	Structured community observations from household surveillance
Detection/Outbreak records	778	More detailed reporting of potential events or signals
Total records	25,646	Overall raw export analyzed
Detection type not populated	273 of 778 Detection/Outbreak records	Classification incompleteness limits interpretation of event records
Routine observations	Ticks, abortions, abnormal livestock deaths, wildlife contact, and wildlife attacks recorded	Demonstrates breadth of community-generated information; not confirmed disease events
Reported notification after abnormal livestock death	3,220 of 6,170 valid responses (54%)	Documents decentralized communication to local or sectoral actors, but not verification or response
Linked verification, response, or feedback record	Not established in the analyzed export	Downstream continuity cannot be assessed from the logbook alone

Discussion

This study examined community-based surveillance as an information pathway within a decentralized One Health system. The COHRIE surveillance records demonstrate that community-level surveillance can generate structured information across human, livestock and wildlife domains and provide mechanisms for communicating potentially important observations to local and sectoral actors.

The findings are important because the contribution of community surveillance to epidemic intelligence is not determined solely by the volume of observations generated. Information becomes operationally useful when observations can be recognized as signals, communicated through appropriate channels and connected to subsequent surveillance processes. The COHRIE records provide clear evidence of the first stages of this pathway, particularly observation, recording and notification.

The range of observations captured through routine surveillance illustrates the value of community-level information at human-animal-wildlife interfaces. Abnormal livestock deaths, abortions, ticks, wildlife contact and wildlife attacks are events that may be encountered within households and communities before they become visible through formal health or veterinary surveillance. Community surveillance can therefore provide an important upstream information layer for One Health systems [3].

The notification findings further demonstrate that community information can cross institutional boundaries. Local leaders and veterinary and animal-health personnel were among the documented recipients of notifications concerning abnormal livestock deaths. This is the central decentralization finding: the pathway does not begin with a central surveillance office, but with information generated near households and routed through local actors who may connect communities to formal sectoral structures. The records do not show whether this distributed pathway improved performance or outcomes; they show how information was positioned to move through the system.

However, notification should not be equated with verification. A reported communication establishes that information was reportedly conveyed to another actor, but it does not establish whether the event was investigated, confirmed, integrated with other surveillance information, or followed by a response. Maintaining this distinction is important for interpreting community surveillance data and for avoiding the classification of routine observations or notifications as confirmed disease events.

The study also highlights the importance of information traceability. Household identifiers and other contextual fields provide a foundation for linking observations over time, while the coexistence of routine surveillance and Detection/Outbreak reporting provides a potential pathway from routine observation to event-level reporting. At the same time, inconsistent identifiers, incomplete classifications, and missing fields can interrupt this linkage. These are not merely technical data-management concerns; they affect the extent to which community-generated information can be reconstructed and interpreted within a surveillance system.

The existence of multiple information channels presents a similar challenge. Electronic data collection, paper records, and communication platforms can support surveillance implementation, but information generated through different channels is most useful when it can be linked to the same underlying event. Without consistent identifiers and dates, separate records may describe the same observation without providing a reliable means of demonstrating their relationship.

These findings support a broader understanding of community surveillance as a component of epidemic intelligence rather than as an isolated reporting mechanism. They also align with wider One Health surveillance frameworks that emphasize interoperability, linked metadata, and information exchange across sectors [7]. The pathway can be conceptualized as observation, signal, information, and, ultimately, intelligence when the information is integrated and interpreted for decision-making. The present data provide evidence for the upstream components of this pathway, while the extent of downstream verification and response requires linkage with records outside the community logbook.

For decentralized One Health surveillance systems, this has implications for the design of community reporting instruments and coordination arrangements. Surveillance systems should make it possible to distinguish routine observations from signals requiring escalation, identify which local or sectoral actor received and interpreted a signal, assign persistent identifiers to important events, capture detection and notification dates, and document subsequent verification and response. Linking information across human, animal, and wildlife sectors is particularly important when an event involves multiple domains.

Such features would allow the information pathway to be reconstructed across organizational levels without recasting the analysis as an evaluation of COHV effectiveness or program impact.

The study also illustrates the importance of data provenance. The difference between the previously reported program total and the current raw export demonstrates that surveillance outputs can vary according to data extraction and reporting processes. Maintaining documented dataset versions, extraction criteria, and data-cleaning procedures is therefore important when surveillance data are used for research and program decision-making.

Taken together, the findings indicate that community surveillance provides an important entry point for decentralized One Health information generation, but that its contribution to epidemic intelligence depends on the continuity of information beyond the initial observation and notification stages. Strengthening the links between these stages can improve the traceability and interpretability of community-generated surveillance information.

Limitations

This analysis was designed to examine the upstream movement of community-generated information through a decentralized surveillance system. The available dataset therefore supported assessment of observation, recording, classification, and reported notification more directly than assessment of downstream verification, investigation, or response, which require linkage with additional operational records. As a retrospective analysis of routinely collected surveillance data, the study used the variables and coding structures available in the source records; this may have limited some cross-record comparisons and aspects of event classification. Differences between the current raw export and previously reported program totals reflect distinct data versions and extraction processes, so earlier totals were used only for contextual comparison. Finally, the records were not designed to estimate reporting sensitivity, population representativeness, notification timeliness, or causal effects. The findings should therefore be interpreted as an analysis of information pathways in the four participating conservation landscapes during the study period, rather than as a national estimate or an evaluation of program performance.

Conclusions

Community-based surveillance generated a broad range of human, animal, and wildlife observations across four Ugandan conservation landscapes and provided documented mechanisms for communicating potentially important observations to local and sectoral actors. The findings show that community surveillance can function as an upstream information layer within decentralized One Health surveillance. Its contribution to epidemic intelligence, however, depends on the continuity of information beyond community observation and notification. Improving event identification, record linkage, and documentation of subsequent verification and response would strengthen the ability of surveillance

systems to trace community-generated information through the wider One Health surveillance pathway and assess its contribution to public-health decision-making.

Abbreviations

COHRIE
Collaborative One Health Research Initiative on Epidemics
COHV
Community One Health Volunteer
IDRC
International Development Research Centre
UVRI
Uganda Virus Research Institute
CTPH
Conservation Through Public Health

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Funding

This work was carried out with the aid of a grant(s) from the International Development Research Centre, Ottawa, Canada; 109807-001, 109976-004, 109976-008.

Author Contribution

S.R.O and D.K. contributed to the conceptualization, methodology, data curation, formal analysis, and manuscript preparation. T.N., R.N., L.T.N., M.H., N.B., G.K., E.P., J.M., M.S., and A.N. contributed to

investigation, data collection and curation, and manuscript review. G.K.-Z. and J.J.L. contributed to supervision, methodological guidance, and critical review of the manuscript. The COHRIE Community Surveillance Team contributed to community surveillance implementation, field investigation, data collection, and data curation. All authors reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

Acknowledgements

The authors acknowledge the COHRIE Community Surveillance Team for its contributions to community surveillance implementation, field investigation, data collection, and data curation, as well as the COHRIE-Uganda research team, Community One Health Volunteers, participating communities, district and conservation authorities, and other partners involved in implementing the community surveillance activities.

Data Availability

The underlying surveillance dataset is not publicly available because it contains potentially identifiable program and household-level information. Data may be made available by the responsible institution subject to applicable ethical and data-governance requirements.

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Figures

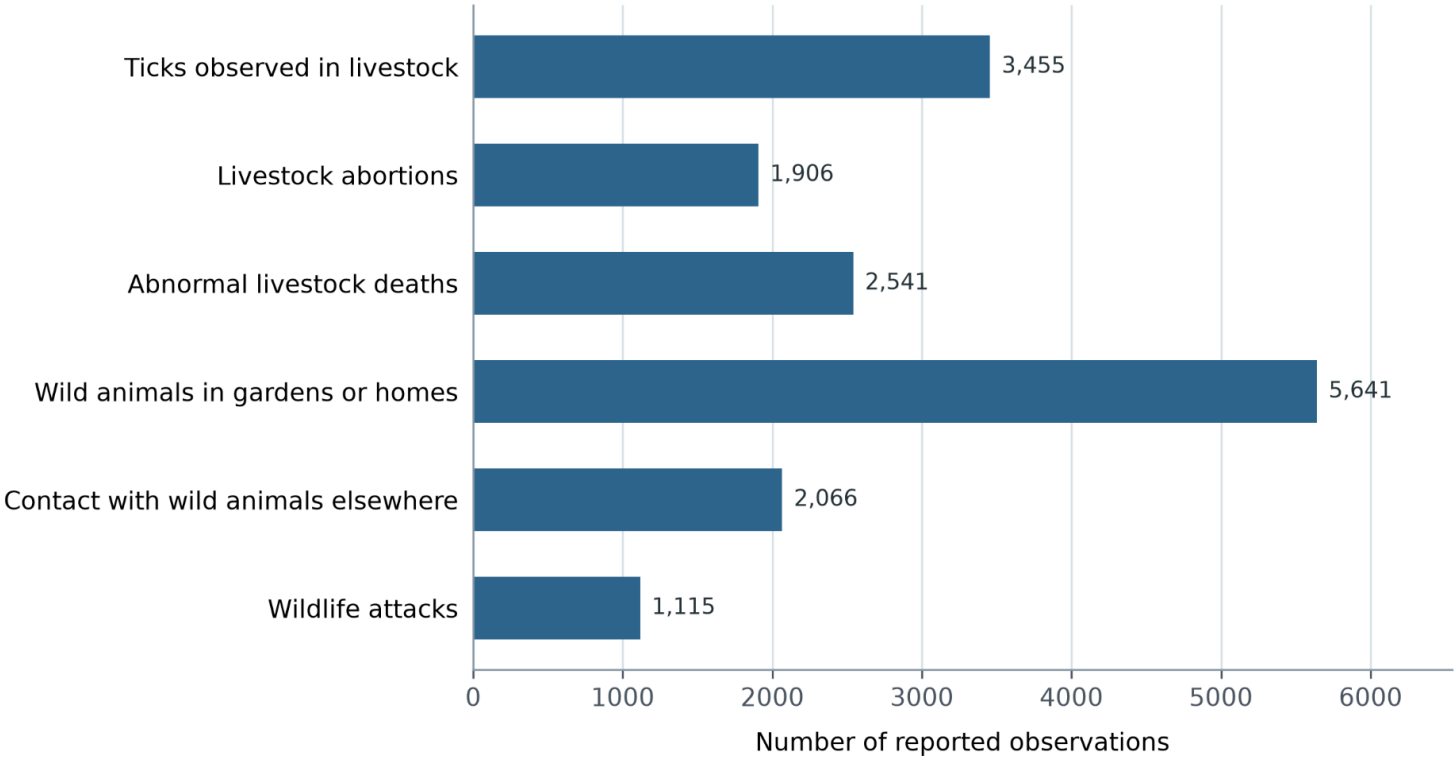

Figure 1

Selected One Health observations recorded through routine surveillance

Counts represent records with a reported observation in the relevant surveillance field. They are not counts of confirmed disease events.

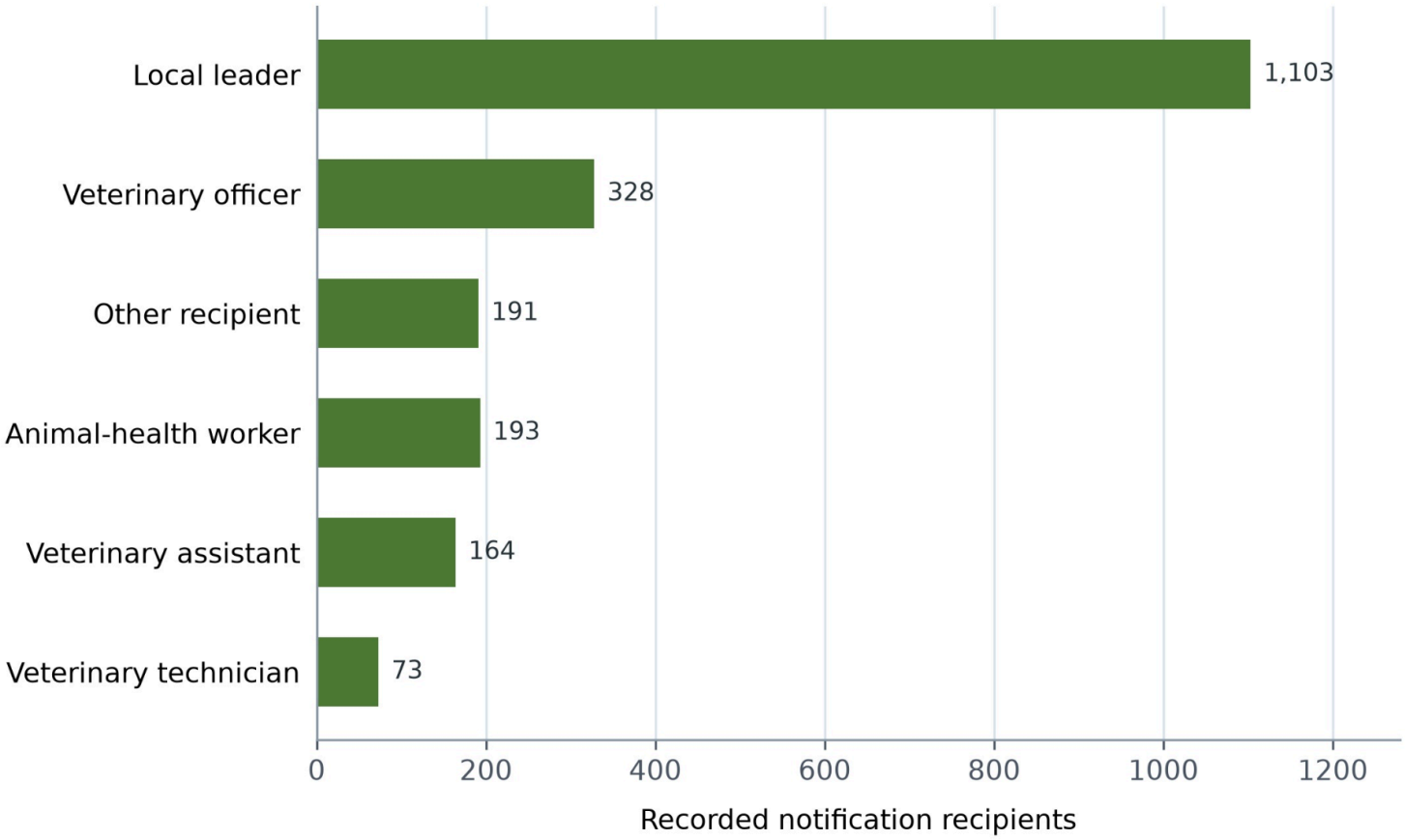

Figure 2

Reported notification recipients following abnormal livestock deaths

Counts represent recorded notification recipients among routine records with a reported notification. Recipient fields were not mutually exclusive.

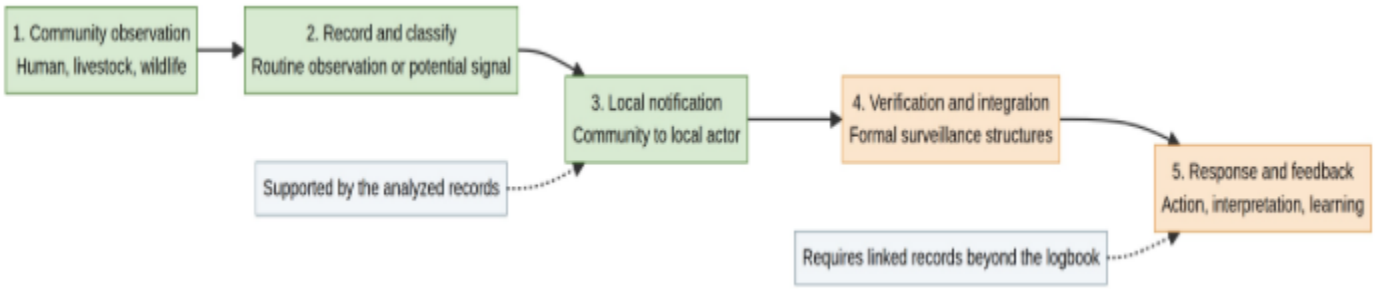

Figure 3

From community observation to One Health epidemic intelligence: the information pathway

The pathway illustrates the conceptual sequence from community observation through recording, classification and local notification to verification, integration, response and feedback. The analyzed

records provide evidence mainly for the upstream stages. The downstream stages require linkage with records beyond the community logbook.

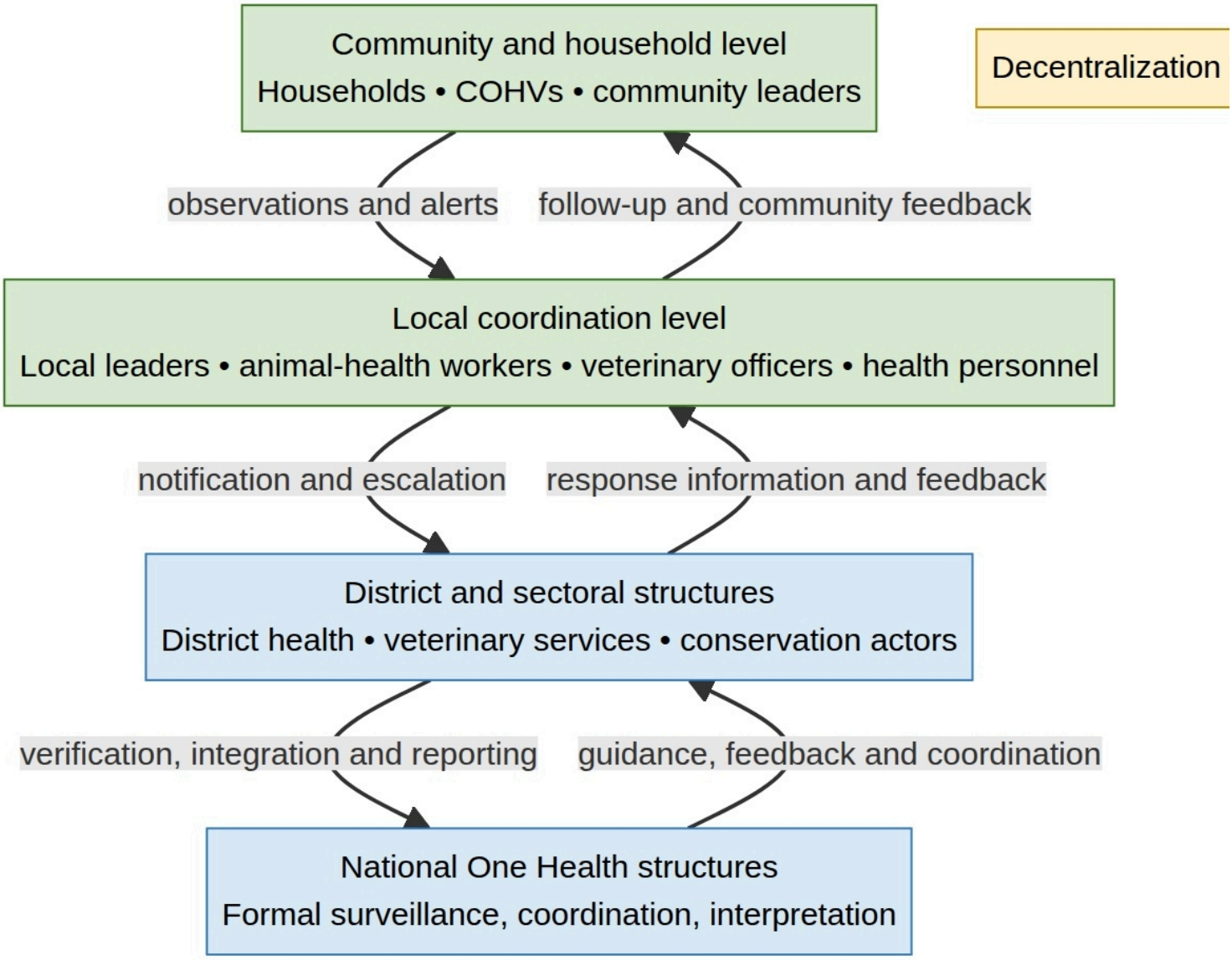

Figure 4

Decentralized One Health information architecture.

Figure 4 presents the decentralized One Health information architecture represented by the surveillance pathway.