The role of community-based programmes and participatory epidemiology in disease surveillance and international trade

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Abstract:

Animal health systems in remote, pastoral areas are increasingly relying on participatory, community-based approaches to service delivery and information collection. The key actors in the field are trained local representative, community-animal health workers. These basic service providers act as communications links between the veterinary services and the livestock owners. This paper describes the role of community animal health workers in surveillance as the eyes and the ears of the veterinary services in remote, extensive production systems. The application of participatory and community-based approaches to surveillance enhances the sensitivity and representativeness of surveillance systems resulting in more reliable assessments of the animal health status.

Introduction:

The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) has established risk analysis as the basis for the regulation of international trade. The Agreement has identified the Office International Des Epizooties (OIE) as the international body charged with drafting international standards for trade in animals and animal products, facilitating the exchange of animal health information and as a forum to coordinate trade risk analysis procedures. The overall goal is to enhance the safety and equality of access to markets by increasing the objectivity and transparency of trade decision-making. The evolving paradigm recognizes science-based surveillance data as the basis of the risk analysis.

"*The ability of the Veterinary Services to substantiate elements of the reports on the animal health situation of their country by surveillance data, results of monitoring programmes and details of disease history is highly relevant to the procedures of risk analysis*." International Animal Health Code, Art 1.3.6.1

The SPS Agreement, in theory, extends the access of developing countries to international markets provided they can meet the data and analytical requirements. A clause stipulates that assistance should be made available to developing countries to transfer the required analytical expertise. In principle, it is the responsibility of the importing country to conduct the analysis, however the exporting country is required to provide sufficient data to substantiate their animal health status.

The trend in the developed world is towards increased reliance on statistically valid methods of laboratory-based surveillance. These methods call for large sample sizes, considerable infrastructure and significant investment that are probably beyond the means of most developing countries. It is unlikely that the more extreme examples of these surveillance measures are cost effective relative to the value of trade, even for the developed countries. In developing countries with extensive, traditional production systems, it is difficult to imagine that such methods are appropriate or achievable. Worse, when laboratory-based methods are applied sporadically, the

results are often misleading. Over the last decade, numerous attempts have been made to implement animal health surveillance and information systems in developing countries based on conventional models developed for intensive, sedentary production systems common in the first world. For the most part, these projects have proved unsustainable.

This paper describes how community-based animal health workers and novel participatory methods of disease surveillance can add value to national veterinary services by improving disease surveillance capabilities according to OIE guidelines. These methods make use of skills, knowledge and resources that are locally available in extensive and remote production systems. The paper suggests approaches to the integration of participatory information collection and community-based service delivery into conventional veterinary service systems. *Community-based and participatory methods augment the capacities of the system, rather than replace conventional capabilities.* The overall aim is to promote a more effective integrated method of surveillance for developing countries that will enhance the quality of data available for risk analysis and trade decision-making while providing better services to traditional farmers.

Integrated Surveillance Methods

Effective surveillance systems are sensitive, specific, timely and representative (Thacker et al., 1988). No one surveillance activity can meet all these requirements. Only an integrated system of complementary methods can. Participatory epidemiological methods and community animal health networks are beginning to be integrated as part of routine disease reporting systems. But so far, the potential benefit of these approaches in terms of enhancing the sensitivity of event detection has only been exploited in the most superficial manner.

Community animal health project staff routinely debrief community animal health workers as to their activities and the types of diseases they encounter. Up to the present, conventional veterinary services have made little use of the information. The reservation is frequently expressed that international authorities would not recognize the data obtained through participatory methods. One of the objectives of the present paper is to advance the discussion and begin to solicit the opinion of the international community regarding methods adapted to traditional production systems.

The starting point for all surveillance is field reports of disease events. Throughout the world, the livestock owner and primary service providers are recognized as the principal source of disease reports and intelligence. A major constraint to western style disease surveillance in the developing world has been the limited availability of formal service providers and the economic conditions that preclude the wide spread presence of formally trained service providers. Further, there is often a significant communication gap between marginalized pastoral communities and conventional veterinary service providers.

In the extensive production systems of the developing world, livestock owners are mostly traditional farmers and primary service providers, where they exist, are usually trained farmer's representatives under the periodic supervision of formally trained professionals. In order for surveillance to be representative, it should include the predominant forms of agriculture and service delivery.

Participatory epidemiology (PE) is the use of participatory methods to collect epidemiologic data. The participatory approach utilizes and compares all available information through a process called triangulation. Triangulation refers to the confirmation of information using multiple methods and multiple sources. Participatory epidemiology makes full use of sampling, laboratory testing and analytical techniques. Participatory studies provide the proper background for the design of statistical studies and the contextual information that is essential to the correct interpretation of laboratory results. Upon several important occasions, qualitative information from PE studies has led to the re-evaluation of the quality of laboratory methods. An important example has been the reassessment of the sensitivity of ELISA tests developed for detecting rinderpest (RP) vaccinal antibody as test for antibody against lineage 2 RP.

In order to fully integrate participatory methods in surveillance systems three important activities are required:

- discussion of the value of participatory data leading to a consensus on its appropriate use,
- training courses in participatory methods for veterinary staff and
- workshops to develop comprehensive frameworks for disease reporting that mobilize CAHW networks in projects, farmers organizations and non-governmental organizations.

Community-based Animal Health Workers and Disease Surveillance

The Need for CAHWs in Surveillance

In order for surveillance systems to function, regular contact is required with livestock owners. In the current economic climate, this has been a constraint for a number of national veterinary services. The operational budgets and transport facilities of veterinary services have been contracting over the last decades and this trend is unlikely to change. These constraints on colonial models have reinforced the trend towards the development of alternative systems of delivery such as private veterinary practice and CAHWs. Just as these approaches are being integrated into service delivery systems, they need to become a core component of the information collection system.

At the present time, networks of community animal health workers exist throughout many regions of the developing world. These individuals are well placed to act as the 'eyes and ears' of the conventional surveillance system and can greatly enhance the sensitivity and representativeness of the limited conventional capacity available.

Community animal health workers have made key unsolicited reports that led to the detection of OIE List A diseases in the past. For example, rinderpest foci in Uganda and southern Sudan have been uncovered by CAHWs on different occasions (Box 1). They also made an early report of an emerging epidemic of respiratory disease in camels that subsequently swept East Africa. This information was beyond value, but someone had to be listening in order for the benefit of the information to be captured.

Box 1.
Community animal health workers as reporters of disease outbreaks

There are examples of field-level reports from CAHWs providing the first indication of important disease outbreaks. In some cases, the diseases in question were of major international importance. For example:

- In Karamoja, Uganda in 1994 and Eastern Equatoria, southern Sudan in 1998, CAHWs provided the first news of rinderpest outbreaks to their supervisors. This information was then transmitted to programme veterinarians who were able to visit the areas in question, collect samples and confirm the presence of rinderpest. This unsolicited action of CAHWs in remote areas can play a crucial role in identifying the remaining foci of rinderpest in the final stages of eradication programmes.

- In the Afar region of Ethiopia, a CAHW provided the first indication that a mysterious respiratory disease was affecting camels in the area. This disease was later to spread through Ethiopia, Somalia and northern Kenya.

Livestock owners, and especially pastoralists, have the ability to recognize and describe most diseases of concern in international trade. A prerequisite for the integration of existing veterinary knowledge (EVK) into surveillance systems is effective participatory practice. An attitude of respect for people and appreciation for the value of farmer's knowledge is required on the part of professionals if they desire the full and open sharing of information. Participatory training for veterinary staff is essential for the success of surveillance systems.

Sustainability of Surveillance Systems

In order for a surveillance system to be sustainable, it must have a perceived benefit to the providers of data. Historically, many surveillance systems have withered due to an extractive data 'mining' design that did not have perceived relevance to the stakeholders who provided the information. Valuable time and information is taken but little of direct value to stakeholders is returned. Ultimately, district level staff, monitors, CAHWs and livestock owners must derive benefit from the output of the surveillance system that they directly recognize as a return on the surveillance workload. Otherwise, the sources of reports will lose interest and the flow of information will stop.

For professional and sub-professional participants one benefit can be timely feedback reports provided by the surveillance system. For CAHWs and livestock owners, oral or participatory information exchanges during the data collection process and specific activities in refresher training workshops that respond to surveillance information would be effective. For the livestock owners, benefits might include appropriate rural radio programmes on diseases they have identified. One aspect of participatory research is that participants learn from the data collection process. Data collection exercises that have elements of 'participant discovery' could be very

valuable to insuring the sustained interest of information providers. Emphasis should be placed on making the data collection process a benefit in itself.

The surveillance system must encompass the needs of the productive sector. The specific needs may include but are not limited to:

⇒ timely advice on current animal health problems through appropriate media;

⇒ timely availability of correct inputs, vaccines and drugs against appropriate payment;

⇒ effective treatment strategies adapted to local conditions;

⇒ management innovations based on traditional approaches that minimise the impact of disease and environmental degradation;

As in any other type of community development, the experts on needs are the participants themselves. Focus group discussions and community dialogue with CAHWs and livestock owners is probably the best route to identifying desirable output from the surveillance system at the community level.

Challenges and Solutions
Most CAHW networks provide for monthly monitoring contacts by a sub-professional, either an assistant veterinarian or production specialist under the supervision of a veterinarian, to review the activities of the CAHW and provide guidance. Ideally, each of these CAHW monitors is responsible for 12 to 15 CAHWs. Regrettably, effective monitoring is often one of the weakest aspects of CAHW networks. This is due, in part, to the failure of authorities to fully appreciate the wealth of surveillance data being missed. Monitoring events are data collection opportunities for the formal veterinary sector both in terms of general disease reporting and active surveillance. The challenges CAHW programs face in establishing effective monitoring programs result in part from the gap between the formal and informally trained sector.

A further constraint has been the lack of effective policy environments and the recognition that CAHW network supervision must operate through market based incentives that reward all levels of the system. The economic rewards must be structured so that both active CAHWs and monitors receive quantity and quality-based incentives. Accurate activity reports and surveillance data from CAHWs to monitors and the monitors to higher levels in the network should be viewed as a quality of service issue. Incentives for activity are usually achieved through mark-ups on the re-supply of drugs. Quality can be maintained by establishing certain standards as a prerequisite for continued participation in re-supply of medicines, participation in refresher training activities, or provision of 'advanced' benefits at cost such as bicycles. Reporting standards can and should be a part of the explicitly defined program standards.

In the better monitoring systems, the CAHW monitors prepare monthly or quarterly summaries of CAHW activities with comments on trends for the project reporting system. In most projects, annual summary reports and end of phase reports summarise global statistics. In addition to animal health information, these reports are often informative in terms of animal health economics. It would be a rewarding process to integrate these reports into a general disease reporting system.

The concerns regarding use of CAHW record keeping systems in surveillance are not fundamentally different from disease reporting systems based on the clinical activities of private and public veterinarians. What these systems lack in specificity, they make up for in their sensitivity and timeliness. As veterinary services are under-represented in remote areas, CAHW involvement usually enhances the representativeness of the animal health picture. Just as was described for overall national surveillance systems, CAHW reporting is only one piece of an effective surveillance system. It is key epidemiological intelligence that must be interpreted in the context of the overall picture.

Where CAHW networks with record systems are in place, this information is not routinely reaching the national surveillance framework. There are various possible reasons for this.

1. In many cases, CAHW networks are not implemented by veterinary services, but by separate lines within the government, projects or non-governmental organizations. Even with the best efforts on all sides, institutional barriers can be difficult to bridge. One approach to promoting effective communication and collaboration is participatory leadership forums where representatives of the

various governmental, project and NGO based programs come together to establish common goals and approaches through dialogue. In addition, field visits to expose decision makers and surveillance workers to the benefits of community-based work that includes surveillance activities would be an appropriate approach as well.

2. Even when CAHWs are identifying serious disease outbreaks, their reports may not be heard, or may become lost within other more routine monitoring information.

   In the case of disease outbreaks, a typical CAHW training course includes training in history taking and basic clinical examination of sick livestock. Therefore, CAHWs obtain useful information on disease outbreaks that can be passed on to formal veterinary workers. Such information does not necessarily have to be written down by the CAHW, who may be illiterate, but can be passed verbally to the monitor.

   When a CAHW reports the occurrence of a serious disease outbreak, the monitor should report this event separately from the routine monitoring mentioned above. It is usually advisable for the monitor to investigate the event using a combination of participatory techniques and conventional disease investigation and sampling procedures (Box 2). Such an approach requires the monitor to collect the testimony of several livestock owners, and if possible inspect some cases. If the disease reported is subject to an official eradication or control programme, such as rinderpest or CBPP, the monitor should comply with any special reporting requirements. In some countries, specific report registries exist for rinderpest and all livestock owner and CAHW reports should be recorded in these registries along with the results of follow-up. If triangulation supports the nature of the report, the monitor, or the concerned CAHWs, should immediately inform district authorities and request a disease investigation.

3. Even where CAHWs and livestock keepers are active in reporting outbreaks of disease, they do not always receive the attention they merit. This is an unfortunate state of affairs, but highlights the communication gap between formally trained service providers, whether public or private, and traditional livestock owners. In addition to the attitudinal issues stressed above, the long-term solution includes increased empowerment of the consumers of services through fee-for-service approaches that minimise the employment entitlement and lack of accountability of tax-funded services.

   In countries that have extensive CAHW networks, it would be useful for a representative of the national surveillance staff to become involved in the training and monitoring of CAHWs, at least on a part-time basis. This will give headquarters staff direct experience with the programme and make them better able to take advantage of the information derived from CAHWs.

   Disease reports from the field may be misinterpreted through misunderstanding of local usage of disease terms. Community-based programmes normally construct lexicons of disease terms and these documents should be made generally available. National surveillance staff should have an inventory of documents covering the EVK of all communities in the country. They actually serve as the case definitions for reporting purposes in the specific communities were they were constructed. In the event that lexicons are not available from all major livestock owning cultures, surveillance staff should conduct participatory surveys to complete the gaps and when necessary, use conventional veterinary investigation methods to relate local disease terminology to western terminology.

Box 2.
Robust sampling methods for use by CAHWs

1. Collection in formalin

Collection of tissues or faeces in formalin is a robust method of sample collection that allows specific diagnoses to be made:

- Tissues can be processed ***histologically*** and examined by a pathologist. Small pieces of diseased tissue 1cm square should be placed in 10% buffered formalin; use at least 20 times the volume of formalin for each sample. Malignant catarrhal fever can be diagnosed using this method.

- Formalin-fixed tissues can be used for ***immunohistological diagnosis*** or ***in situ hybridisation*** with genetic probes. These techniques can be performed on fixed samples collected months or even years previously. Research has shown that even moderately autolysed samples can be diagnostic. It is of value to collect tissues from carcasses up to 24 hours old. This technique is most useful when a particular disease or set of disease is targeted for study and confirmation. Prior to implementing a sampling scheme, laboratories need to be identified that are both willing and capable to carry out the desired testing. Although the testing is relatively simple, basic histological preparation capabilities (sectioning and staining) are not always present at the national level. After 7 days in 10% buffered formalin samples can and should be transferred to phosphate buffered saline or normal saline. Provided the host and destination countries agree, samples can be mailed to appropriate laboratories for testing – formalin-fixed tissues are stable and non-infectious. The samples should be small in quantity and well sealed in unbreakable laboratory grade containers obtained from a scientific supply source. A wide range of viral, bacterial and parasitic diseases such as rinderpest, peste des petits ruminants or hog cholera or heart water can be diagnosed using this method provided the laboratory has a specific antibody for the disease of interest.

- It is also possible to extract genetic material from formalin fixed tissues for ***polymerase chain reaction (PCR)*** analysis. In PCR, small quantities of genetic material are amplified enzymatically for identification by genetic probes or sequencing. Techniques for the diagnosis of most major animal disease have been described in the literature and PCR-based diagnosis is rapidly becoming the diagnostic standard. This technique can be readily applied to viral, bacterial and parasitic diseases such as bluetongue, foot and mouth disease, CBPP or East Coast fever.

- Faeces that have been fixed in formalin can be used for ***worm eggs counts*** and detection of ***fluke eggs***. Approximately 3g of faeces is placed in around 20ml of 10% formalin and thoroughly mixed. The formalin prevents the parasite eggs hatching.

2. Collection of samples in alcohol (70% ethanol)

- Parasites such as ***ticks, flies, lice, gut worms and flukes*** can be preserved in 70% alcohol.
- ***Lice*** can be detected from hair samples plucked from infected animals.
- Tissue samples in 70% ethanol also suitable for PCR diagnosis

3. Collection of dried samples

- CAHWs can prepare ***blood smears*** that are air-dried and wrapped in tissue paper. Care must be taken to protect the slides from flies during drying or the entire sample can ‘disappear’ in a matter of minutes. These samples are useful for the diagnosis of various haemoparasitic and some bacterial infections.

- Sera can be blotted and dried on ***filter paper*** and then placed in plastic bags. Once in the lab, the samples can be eluted with buffers and tested serologically or for the presence of infectious agents. Although the drying process undoubtedly reduces the sensitivity of the isolation process, isolation or antigen detection is diagnostic. Diseases that can be diagnosed using this method include Newcastle’s disease.

Recent Developments
A recent review of OIE guidelines has clearly shown how CAHWs can strengthen national veterinary services (Leyland and Catley, 2002). The key opportunities with regards disease surveillance are summarised in Box 3.

In addition, countries in East Africa and the Horn of Africa are beginning to incorporate CAHWs into national surveillance systems.

- In Tanzania, the PACE programme is working with NGO partners to develop standardised formats for CAHWs and links reporting to government offices.

- PACE Ethiopia is also seeking to incorporate information derived from CAHWs into the national surveillance system. A workshop in the Somali region in March 2002 brought together government epidemiologists and NGO veterinary staff to develop a system for linking CAHW report to the central epidemiology unit.

Participatory Epidemiology
Participatory epidemiology is the collection of epidemiologic data and intelligence using the widely accepted methods of participatory rural appraisal (PRA) or participatory learning and action (PLA) (Table 1). Participatory rural appraisal consists of a toolkit of methods for rapid and accurate data collection largely developed for the project design, monitoring and evaluation.

Participatory epidemiology relies on the well-developed EVK of traditional livestock owners. For the most part, communities that depend heavily on livestock for their livelihoods can reliably recognize the OIE List A diseases and many List B diseases that occur in their area. This includes the major trans-boundary diseases such as foot and mouth, rinderpest, peste des petits ruminants, Newcastle disease and contagious bovine pleuropneumonia, to name just a few.

Box 3.
How CAHWs can strengthen surveillance.

In their review of CAHW networks relative to the OIE guidelines for the evaluation of veterinary services, Leyland and Catley (2002) note that the guidelines open the door for developing countries to demonstrate improved services and surveillance in marginalised areas through the use of CAHW systems.

- Community animal health workers can contribute to animal identification systems, tracing systems and animal movement control systems.
- In remote areas "… veterinary services need to be able to show that despite communication difficulties they maintain '*reliable knowledge of the state of animal health'* and the ability to implement '*animal disease control programmes'* in a given zone. Community-based animal health delivery systems have proven to be useful for improving both disease surveillance and disease control in such areas."
- Community animal health workers move with nomadic and transhumant pastoralists. They offer the opportunity to coordinate animal health surveillance and control across wide areas. They make unique contributions in border areas, across frontiers and areas of insecurity where activities of conventional service providers are often highly restricted or prohibited.
- In their role as carriers of extension messages, CAHWs promote compliance with drug withdrawal times and correct dosage regimens.
- The OIE recommends that veterinary services develop operational plans with performance indicators. Many CAHW projects utilise operational plans and performance monitoring to measure the amount of activity that conforms to minimum standards.

Existing veterinary knowledge is specific to each community and utilizes local language terms, but recognizes common clinical presentations, epidemiological patterns of disease, vectors and reservoirs. In the developing world where laboratory data is limited, intelligence derived from participatory studies often provides a more accurate description of disease status. When integrated with targeted laboratory studies, participatory data provides the context for realistic interpretation of laboratory results.

Positive Impact of Participatory Methods in Clinical Surveillance

Numerous examples of the positive impact of targeted participatory studies on the extent of knowledge of the epidemiologic status of specific populations are available in reports and in the literature. Frequently, participatory assessments identify the presence of diseases such as PPR, RP and CBPP that were not previously know to be occurring in the populations studied.

Participatory epidemiological assessments usually start out by studying the community, animal populations and productions systems present. This begins through a consultation of existing sources on local sociology, production, and epidemiology. Thereafter the study moves to the field and interviews key informants as to the disease priorities in the area. This usually starts with open-ended questions about the disease problems in the area and the construction of list of problems and their descriptions. Thereafter, the team can probe specific subjects in more detail using a spectrum of techniques. The final product is a report outlining the major diseases and essential conclusions relative to the objectives of the study.

Participatory epidemiological studies are usually undertaken at the level of the community or ethnic group. This is because a community's knowledge forms a cohesive body of information. From an epidemiologic perspective, the community structure also defines the livestock population structure. How people interact determines how their livestock interact. Whereas, understanding market and industry structure may be the main concern in the developed world, traditional interactions and culture are still the primary epidemiologic determinant in many countries. Participatory studies are well suited to the risk categorization of populations as part of zonation programmes.

Participatory disease searching (PDS) is a form of participatory epidemiology adapted to targeted surveillance for rinderpest as part of the Global Rinderpest Eradication Programme (GREP). It is now being widely applied as a method of assessing rinderpest risk, verifying eradication and substantiating disease freedom. In regard to the OIE guidelines for rinderpest surveillance, PDS has considerably enhanced the ability of veterinary services to detect clinical disease, if it were present.

Participatory disease searching is now relied upon as the primary clinical surveillance tool in the three remaining rinderpest foci: Sudan, the Somali production system and Pakistan. As PDS makes use of traditional knowledge, historical information and the extensive oral communication networks in pastoral areas, it is a much more sensitive and reliable method of clinical surveillance than randomized clinical surveillance.

The OIE guidelines stipulate that serological and clinical rinderpest surveillance should be based on random samples with a sample size sufficient to detect clinical rinderpest with 95% confidence if it were present at a level of 1% prevalence of greater. Antibody prevalence accumulates in the population and surveillance to a level of 1% prevalence makes perfect sense in serosurveys as objective verification of disease eradication. On the other hand, the clinical prevalence of rinderpest is usually of the order of 0.1% and even in the most catastrophic epidemics is unlikely to reach a prevalence of 1%. The current OIE recommendation is unlikely to detect clinical rinderpest, if it were present. At best it is a waste of resources and at worst could lead to undetected residual foci that result in an international resurgence of disease. Randomized clinical surveillance is an example of inappropriate application of statistical epidemiology where much more simple, sensitive and effective means exist that identify and target high-risk areas.

Table 1: Participatory Epidemiological Methods

Notes	References
Recognition of the indigenous knowledge of livestock keepers by veterinarians, including early descriptions of local disease terminology and perceptions of causation	Mares (1954); Schwabe and Kuojok (1981)
Comparing livestock keeper-derived diagnoses with serological assessments of prevalence	McDermott et al. (1987); Baumann (1990)
General accounts on the use of participatory methods by rural development workers and veterinarians	Leyland (1991); Young (1992); Ghirotti (1993)
Descriptions of specific participatory methods for understanding animal diseases:	
- Wealth ranking and disease ranking	Maranga (1992); Leyland (1992)
- Informal interviewing	Grandin and Young (1994)
- Method for 'interviewing cows'.	IIED and ActionAid (1992)
- Seasonal calendars	Hadrill and Yusuf (1994b)
- Movement maps	Hadrill and Yusuf (1994a)
- Progeny history method	Iles (1994)
- Venn diagrams	Braganca (1994)
- Livestock disease scoring	Catley and Mohammed (1996)
Emergence of 'participatory disease searching' (PDS) in rinderpest eradication	Mariner and Flanagan (1996)
Reviews focusing on usage of participatory methods by veterinarians, leading to studies on reliability and validity plus development of standardized but flexible methods:	Catley (1999; 2000)
- Matrix scoring	Catley et al. (2001)
- Seasonal calendars	Catley et al. (2002a)
- Proportional piling	Catley et al. (2002b)
Development of rinderpest disease model using data collected using participatory methods	Mariner (2001)
Emergence of 'participatory epidemiology' as a distinct branch of epidemiology. Development of training manual and workshops to review experiences	Mariner (2000); Catley and Mariner (2001).

Conclusion

Community-based and participatory surveillance methods do not replace conventional surveillance and analytical capacities. They extend the capabilities of the system by enhancing the penetration of data collection activities into the traditional communities, especially in remote and extensive systems. The OIE guidelines state:

"*Investigation of the suspicion of cases of animal disease is one of the most important means of agent surveillance*." International Animal Health Code 2002, Art 1.3.6.2

In order to investigate suspicious cases you must first detect them. Community animal health workers are local experts and the ground-level eyes and ears of a surveillance system in remote areas.

Community animal health workers do not conduct epidemiological investigations. They assist veterinarians using PE or other epidemiological methods by acting as entry points to the community:

- providing a link between veterinarians and communities. CAHWs are trusted members of a community and can help to establish good rapport and understanding between the veterinarians and community members;
- acting as key informants e.g. by identifying other key informants in the community and providing information on the local disease situation;
- helping to organize community meetings, visits to herds, sampling and so on; if trained and supervised, CAHWs can also be very useful for sample collection;
- assisting with feedback of results to the community.

Therefore, CAHWs do not replace formal investigations but can trigger investigations and greatly assist veterinarians who are undertaking these activities in marginalized areas.

Participatory epidemiology is the application of participatory approaches to improve the understanding of the animal disease situation. A key feature of PE is triangulation or crosschecking information derived from multiple sources and methods. This includes conventional approaches such as clinical and pathological examination, and laboratory diagnosis. *Participatory epidemiology assumes that surveillance is a set of integrated activities and veterinarians (not CAHWs) who have been trained in the approach conduct PE investigations.*

The goal of the SPS Agreement and the OIE standards is to promote trade in a safe and transparent manner. Effective service delivery and surveillance systems are a prerequisite for participation in international trade. The important consideration is that surveillance data provided for trade decision analysis is sensitive, reliable and representative. A variety of complementary methods adapted to the local environment are required to reach these goals. It is doubtful that effective service delivery and surveillance systems can exist in extensive production systems without community-based and participatory systems. Appropriate combinations of participatory, laboratory-based and analytical epidemiology will result in the strongest overall surveillance system that best represents the true epidemiological picture.

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