CHALLENGING ENVIRONMENT

Capacity development for integrated surveillance: the 'One Health' for Asia programme

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Abstract

The emergence of diseases such as SARS, HPAI and H1N1 influenza from animal source populations – to name but a few – has been a driving force behind the development of the 'One Health' movement, and helped raise its profile. Effective surveillance for such emerging diseases is a prerequisite for an adequate response. The rapid globalisation of these diseases has emphasized the enormous challenges of early identification and control, and highlighted the need for cross-border and trans-disciplinary action. It has also exposed a serious deficit of capacity and coordination in dealing effectively with emerging disease threats. This is particularly acute in the developing world, which is the least well-equipped to react to such threats. Paradoxically, this is where the likelihood of the emergence of novel epidemic strains is the highest. Capacity development is urgently required in these areas on different levels: individual skills development, institutional strengthening, and policy building.

This paper describes a 'One Health' capacity development programme in Asia, with specific reference to surveillance activities. The programme consists of two phases: the first phase provides Masters level training of public health doctors and veterinarians; the second phase will establish and support trans-disciplinary professional networks, which will enable the development of activities including implementation of operational projects and applied research, collaboration, continuing professional development, *etc.*

Keywords: One Health; training; professional networks.

Introduction: the 'One Health' paradigm

To illustrate the importance of emerging infectious diseases, a frequently cited statistic is that approximately 75% of such diseases in humans originate from animal populations, and of all known human infectious diseases, 60% are zoonotic [1]. The emergence of novel pathogenic disease strains in the previous decades is likely to have been accelerated by the escalating interdependency between humans, animals and the environment. Factors such as increased contact rates between human and animal populations, habitat degradation, intensive livestock production practices, international travel, heightened public awareness, animal movements and trade [2, 3, 4] help bring about the emergence of such infections. International trade in live animals and food products contributes to the rapid global spread of zoonotic threats [5].

The 'One Health' approach presents an inclusive and integrated framework which straddles human, animal and ecosystem health. It recognises the intrinsic importance of cross-sectoral surveillance as a key element of early detection of disease outbreaks. The operational surveillance systems designed for emerging zoonotic diseases should have a joint design [6]. Such collaborative systems require integrated teams of veterinarians and public health professionals, particularly in leadership roles; the foundation of this begins with education and collaborative research [1, 3].

Despite its philosophical appeal, the 'One Health' paradigm is the subject of much discussion. While the concept is not new, practical implementation of 'One Health' activities has only relatively recently begun to be realised. Impediments to its adoption include:

- There is no coherent or universal definition of what 'One Health' stands for, which leads to the perception in some quarters of it being vague and "new-worldy".
- The "branching" of human and veterinary epidemiology during the 20th century has brought about increasing specialization and complexity in both fields. This has inevitably led to the development of established institutional cultures, very different priorities, and some degree of resistance to change. The diversification of our professional vocabulary leads to inconsistent definitions and hampers effective communication. An additional factor mentioned is that human clinical medicine tends to have a focus on the individual level, whereas veterinarians are more accustomed to thinking on the herd level [5].
- Practical, logistic and organisational constraints: establishing meaningful collaborations requires the initiation of new working relationships, developing different modes of communication, agreeing on "who does what", *etc.* Such things take time to mature.

The capacity to detect and respond adequately to emerging infectious disease threats, in terms of "on the ground" expertise and capacity as well as human and physical resources, is most constrained in the developing world, where the likelihood of such diseases emerging is paradoxically the greatest. Interestingly, these areas also tend to be more receptive to 'One Health' approaches. Explanations may be that veterinary and public health frameworks may not be as specialised and historically entrenched as in developed countries; agriculture plays a more significant role in peoples' livelihoods; changing land-use patterns and resource management are putting more pressure on the environment; there are more frequent and closer

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contacts between humans, livestock and wildlife; and the higher burden of zoonotic diseases increases the relevance and impact of effective intervention.

The urgent need for capacity development has been acknowledged in these areas on different levels: individual skills development, institutional strengthening and policy building. In the wake of the emergence of HPAI and the pandemic H1N1 influenza strain, there has been a huge investment in research, physical resources and facilities, surveillance, preparedness and contingency planning for pandemic disease outbreaks. A real momentum is growing, and collaborative 'One Health' initiatives are increasingly being implemented. The FAO, WHO and OIE are among the "early adopters"; they were ahead of their time when they launched a global early warning system for animal diseases transmissible to humans in 2006 [7], and have recently published a tripartite concept note to develop a joint framework for further coordinating activities [8]. USAID is making a large investment to establish an emerging pandemic threats programme [9]. The CDC's well-established field epidemiology and laboratory training programs (FE(L)TPs) also train veterinarians [10].

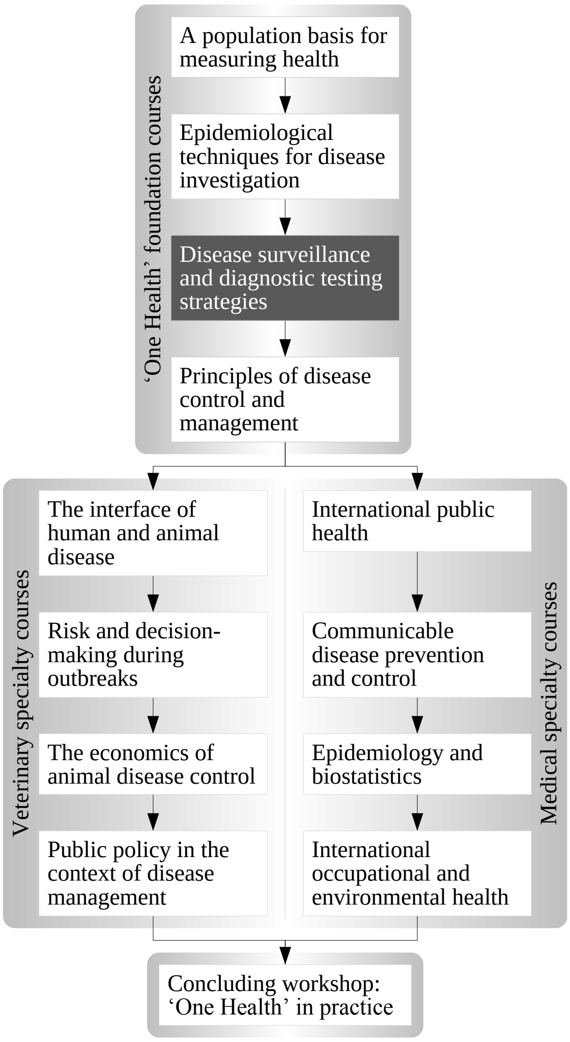
The 'One Health' for Asia programme

Massey University is developing a capacity development programme to strengthen the response to outbreaks of major human and animal infectious diseases in three sub-regions of Asia (South Asia, Central Asia and East Asia). The programme consists of two phases: phase one provides Masters level training of public health doctors and veterinarians; phase two will establish and strengthen trans-disciplinary professional networks to ensure sustainability and implementation of applied activities.

Masters Degree training: Two Masters Degree programmes are being offered collaboratively by Massey University's EpiCentre and Centre for Public Health Research. Currently, 67 candidates from six countries in South Asia are enrolled. Candidates with backgrounds in human health will obtain a Master of Public Health (Biosecurity), while those with a background in animal health will obtain a Master of Veterinary Medicine (Biosecurity). These study programmes are of 15 months' duration. The objective is to develop epidemiological and public health skills which can be applied to practical health and biosecurity management tasks of the nature faced by disease control officials in Asia. The candidates are professionals with medical and veterinary degrees and relevant experience in disease control activities. Equal numbers of medical and veterinary professionals are enrolled. Concurrent training of individuals working in public health and in animal health will foster interaction, communication and active collaboration between the two professional groups, as well as between the participating countries, in alignment with the 'One Health' concept.

The training programme has been designed for part-time study to allow candidates to complete a relevant degree, at a manageable pace, without impacting heavily on their day-to-day employment duties. The training requires completion of eight courses. The first four courses provide a foundation in epidemiology and are common to both degrees: they cover 1) basic principles of epidemiology, 2) disease investigation, 3) disease surveillance and 4) disease control and management. The remaining four courses address specialised topics related to human or animal health, as shown in Figure 1. Workshops are organised at a regional venue before commencement and after completion of the degree programme.

Figure 1: Structure of the 'One Health' MVM / MPH (Biosecurity) degree. All courses are taken in sequence. The third foundation course is dedicated to surveillance



Each of the eight courses requires the equivalent of 3 weeks' full-time study, distributed over a six-week period at 15 to 25 study hours per week. The first three courses are delivered entirely using Massey University's online Learning Management System (LMS). The fourth course is taught partly online, and partly in a regional face-to-face intensive training session. The remaining four specialty courses are delivered entirely online. There is an emphasis on problem-based learning using case studies and examples that are specifically tailored to health issues of regional relevance. Candidates are frequently required to complete applied activities and learning assessments. Small group activities constantly reinforce the importance of communication and collaboration. Assessment is by a combination of continuous assessment, submitted assignments and summative assessments at the completion of each course. All candidates are provided with a laptop with required software preinstalled. Although no high-speed broadband connection is required, access to the internet is essential due to the focus on online delivery.

'One Health' hubs: The second phase of the programme is support for the establishment of 'One Health' hubs. The direct objective is to promote in-region sustainability of the epidemiological and biosecurity skills that will be gained by the participants as part of the Masters Degree training.

These hubs will predominantly operate as regionally-hosted and administered web platforms which enable communication, information sharing and data storage. They will provide a professional network for ongoing collaboration, education, organisation of regional meetings, and cross-sectoral operational activities (including surveillance) and applied research. While membership of the hubs will initially consist of graduates of the degree programme, it will not be limited to this, and the hubs will attract and involve other professionals. They are expected to liaise with national, regional and international regulatory bodies and take a lead role in policy development, advisory functions and decision-making. Additionally, the hubs are expected to serve as a common resource for publicly promoting activities that serve the benefit of both animal and public health.

Eventually, the intention is that the hubs will provide an infrastructure for conducting self-sponsored training of additional veterinary and medical workers.

The importance of surveillance in the programme

One foundation course is dedicated specifically to surveillance (Figure 1). The first course topic covers the epidemiological basis, criteria and practical requirements of monitoring and surveillance systems, screening programmes and registries. It describes the disease categories for national and international surveillance, and considers different sources of data and information for surveillance purposes. The second topic covers implementational aspects of surveillance and screening systems, including planning, interpretation of data, initiating appropriate action when required, and evaluating the effectiveness of surveillance, monitoring and screening programmes. The third topic evaluates the role of diagnostic tests in surveillance.

As there is substantial overlap between epidemiological concepts, it is inevitable that the degree courses are highly scaffolded and frequently cross-reference each other. Many of the other courses relate to disease surveillance, or present it in different contexts. For example, the course on disease control and management emphasizes surveillance as being an essential component of integrated disease control programmes. In contrast, the specialty course on the interface between human and animal health highlights the importance of surveillance for early identification of emerging infections, as well as considering multiple reservoir species. The animal health economics course applies economic tools to assess the relative costs and benefits associated with different surveillance strategies.

Training of individuals in epidemiology, disease control and biosecurity-related concepts is essential to strengthen the capacity for disease management; this need is particularly acute in the developing world. Such training should include medical as well as veterinary professionals. The development and delivery of two closely aligned Masterates, which have a 50% overlap aimed at developing a shared vocabulary to facilitate communication, illustrates the importance attached to the 'One Health' concept. Our experience to date indicates this approach is working: there is a remarkable buy-in of students from both professions, and a high level of collaboration.

Acknowledgements

This programme is financed by the European Commission's Animal and Human Influenza Facility (AHIF), the funding of which is managed by the World Bank (WB). The author would like to acknowledge the input of the programme team and the feedback from the candidates.

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Evaluation of surveillance systems in animal health: the need to adapt the tools to the contexts of developing countries, results from a regional workshop in South East Asia

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Abstract

A central issue in disease management is how to construct permanent surveillance networks that are capable of promptly detecting the emergence of an epizootic to enable a rapid reaction. The capacity of surveillance networks to detect a real emergence in a cost effective way has to be evaluated. Standard evaluation methods are generally qualitative or semi-quantitative and are often subjective and the tools developed to counterpart their subjectivity are not adapted to the specific contexts of developing countries. The objective of this work is to evaluate the needs for each country and the possibility of using SNAT (Surveillance Network Analysis Tool) as the first standardized tool to evaluate the avian influenza surveillance networks in Southeast Asia. There are great needs for developing countries to evaluate their surveillance systems either to identify the critical points for improvement or for presentation to the donors. However SNAT under its current format is not yet applicable to developing countries. The tool should be further developed to integrate each country needs and to identify and prioritize the means of action for improvement according to specific socio-economical contexts.

Keywords: evaluation, evaluation tool, surveillance, developing countries.

Introduction

The avian influenza (AI) panzootic caused by highly pathogenic H5N1 subtype, the risk of new highly pathogenic strains emerging on an intercontinental level, and the risk that a pandemic strain may develop require the reinforcement of controls at the animal level in priority in countries where the disease is recurrent or enzootic, particularly in Southeast Asia (SEA). A central issue in disease management is how to construct permanent surveillance networks that are capable of promptly detecting the emergence of an epizootic to enable a rapid reaction. This issue is even more important in developing countries where human and financial resources are limited and geographic access and communications are sometimes very restricted. Surveillance networks must be evaluated in terms of their sensitivity and predictive value -- their capacity to detect a real emergence within a defined spatial and temporal framework – and their desired cost effectiveness. Standard evaluation methods are generally qualitative or semi-quantitative and are often subjective. Under the framework of the research programme for the Evaluation of Avian Influenza Surveillance in South East Asia (REVASIA) the quality and operational efficacy of the surveillance systems of AI in SEA countries need to be evaluated. The results of these evaluations will be used as a basis of comparison with the methods for evaluation developed within the framework of the project. A Surveillance Network Analysis Tool (SNAT or OASIS in French) based on qualitative and semi-quantitative evaluation methods has been developed in Europe by a group of expert from ANSES (French agency for food, environmental and occupational health safety) [1, 2]. The objective of this work was to identify the needs and the potential of this tool to evaluate AI surveillance networks in SEA.

Materials and methods

Several meetings were organized to identify the needs and gaps in the evaluation of AI surveillance networks within the different countries (Cambodia, Lao, Thailand and Vietnam). A regional workshop was organized in Hanoi in November 2010 to discuss the acceptability of the tool to be used in the evaluation of the surveillance networks in the field and to draw recommendations for adapting the tool accordingly. The meeting gathered 30 participants from national Veterinary Services, laboratory experts and University researchers from Cambodia (National Veterinary Research Institute), Lao (National Animal Health Center), Thailand (Department for Livestock Development and Kasetsart University) and Vietnam (Department of Animal Health & National Center for Veterinary Diagnostic; National Veterinary Research Institute; Hanoi Agriculture University and National Institute for Hygiene and Epidemiology); international experts from United Nations organizations (FAO,WHO) and international institutes (CIRAD, CDC). The main objectives of the workshop were 1) to present the tool to the actors of the surveillance in SEA; 2) to have an overview of the AI surveillance systems existing in SEA and 3) to discuss and adapt the tool to the AI surveillance networks and to the socio-economical context of SEA countries. Specific group discussions had to review the questionnaire and the scoring method by evaluating a scenario surveillance system created for the purpose of the workshop. Each group had to consider the issues of 1) adequacy of the tool to the context of AI disease in SEA countries; 2) simplicity and understanding of the tool; 3) needs and recommendations for improvement.

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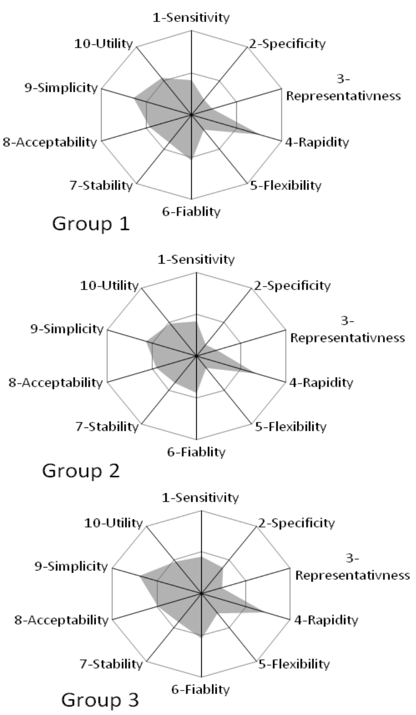
Result and Discussion

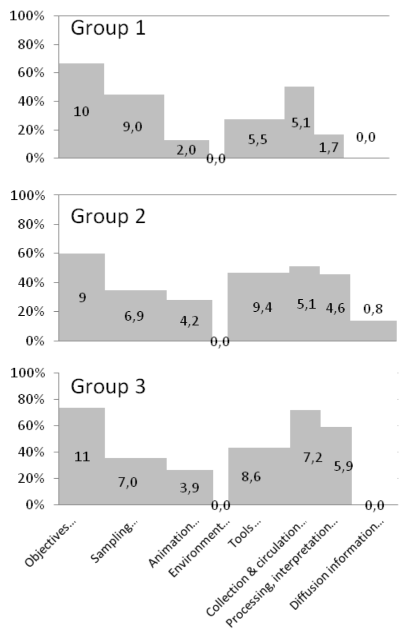
There was a general consensus on the need for an evaluation of the surveillance systems in animal health as a critical part of the surveillance process. A better understanding of the weaknesses of the system is required to identify the gaps for improvement. However, the methods currently used for evaluation (including the methods used in SNAT) are highly subjective and rely on the evaluator background and level of expertise. SNAT was recognized as the first standardized tool trying to reduce some of this subjectivity by relying on closed questions and precise scoring criteria. Results from the scoring exercise clearly demonstrated this subjectivity. Only limited variability was observed when looking at the qualitative assessment results: 1) satisfactory level of the process (results not shown) and 2) strength/weaknesses of the systems according to defined quality criteria [2] (Figure 1). The variability between experts was greater when looking at the results from the semi-quantitative assessment. Different trends in ranking the critical points of the system according to the margins for improvement were observed between the experts (Figure 2).

Figure 1: Results from the quality assessment of the scenario surveillance network by the three work groups



The tool was originally developed for the evaluation of surveillance systems in industrialized countries. Under its current format the tool is not yet applicable to South East Asia contexts: it is too long, too complex or not straight forward enough and would need to be simplified (both the questionnaire and scoring method) to be applicable in SEA. One recommendation was to adapt the outputs of the tool to the different objectives of each country in the evaluation of their surveillance systems (*e.g.* internal use for improvement; argument for donors etc…). This will have an impact on the number of criteria required to evaluate the system and its prioritization could help reducing the complexity of the tool (Table 1).

Figure 2: Results from the semi-quantitative assessment of the scenario surveillance network by the three work groups



Under its current development, the tool only highlights the strengths and weaknesses of the system organization. However, the purpose of evaluation is also to help decision makers and any tool should be easy to use to ensure its implementation in the field. This means easy way of identification of corrective measures to be implemented to improve the system. Highlighting and prioritizing the components where the measures should be applied to improve the system, including a cost-efficacy approach, is a priority.

Table 1: Number of scoring criteria involved in the assessment of each of the quality components

Quality components	Number of scoring criteria involved
Sensitivity	12
Specificity	5
Representativeness	6
Rapidity	10
Flexibility	10
Reliability	48
Stability	24
Acceptability	19
Simplicity	7
Utility	13

Within the "one health" approach bridges between animal and public health surveillance are needed to reinforce the strengths of the systems. The issue of cross-cutting with public health and wildlife surveillance needs to be accounted for within any evaluation tool.

SNAT is a potential efficient tool to address the needs in evaluating animal health surveillance systems. All the representatives from the countries along with the international organization recognize the importance of such a tool and the needs for its development. Some countries such as Vietnam and Thailand have already included evaluation indicators within their systems. However they acknowledged the interest for a more generic and standardized approach to improve the accuracy of their evaluation. The need to involve a third party (an external expert) to increase the objectivity and credibility for presentation to the donors was highlighted.

SNAT is an evolving tool that needs be developed with the government of the SEA countries for its implementation in the field. Pilot field studies to further develop the tool are already planned in Cambodia and Lao. This development will take into consideration the epidemiological and socio-economical specific contexts of each country.

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Acknowledgements

This work was funded by the French Ministry of Agriculture special funds for avian influenza research (FRIA 08-009 (REVASIA)). The authors would like to acknowledge all the representatives from Cambodia, Lao, Thailand and Vietnam and from the UN organizations for their participation and valuable inputs and discussions during the meetings and workshops.

CaribVET charter, a tool for institutionalization and sustainability of a regional animal health network

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Abstract

A collaborative approach is essential for surveillance and control of transboundary animal diseases. Establishing networks offers the possibility to define regional strategies for surveillance and control, sharing expertise, developing technical programmes, and building capacity. CaribVET, the Caribbean Animal Health Network emerged more than a decade ago starting by regional technical activities strengthening the countries' capacity to safeguard and manage the incidence of transboundary diseases. The Network has progressively achieved recognition as the animal health network in the Caribbean. It was endorsed as a safeguarding tool for use in 2006 by the Caribbean Community (CARICOM) which comprises 15 Member States and 5 Associate Member States. By 2010 membership in CaribVET has expanded to 31 countries and territories and 10 regional/international organizations, universities and research institutes. The Members of the Network in visioning for its future have created a Charter in order to solidify its sustainability. The Charter gives quasi-legal status, defining terms of reference; objectives of the network; membership; chairmanship; organizational structure, operational procedures, internal and external communication and prescriptions for funding. This charter is considered by the members of the network as an essential institutionalization tool for facilitating the development of cohesive programmes, maintaining transparency and creating trust among all members, providing information on the network to partners; mobilizing technical and financial resources, and engaging in cooperation agreements with international organizations. In essence the charter is one of the keys element considered fundamental for the sustainability of this regional network.

Keywords: Epidemiosurveillance, surveillance network, Caribbean, veterinary services, animal health.

Introduction

Increased globalization, trade, and animal and human movements intensify the global economic and social impact of animal diseases, in particular those transmissible to man. Countries that trade in live animals and products of animal origin have a requirement to conduct effective surveillance to allow early detection of known and emerging and re-emerging diseases, to allow rapid response at control, to protect trade partners from the risk of a foreign animal disease outbreak, and to comply with the World Organization for Animal Health (OIE) guidelines [Vallat *et al*., 2006; Kloeze *et al*., 2010]. It is therefore, an important benefit for countries to have an established surveillance network that links animal health diagnosticians in laboratories, animal experts and veterinary services. At the regional level, when the veterinary services fail in a single country, it is the entire region that could be threatened. Animal disease outbreaks are even more of a problem when they occur in countries that have no effective surveillance and preventive animal health network [Angot *et al*., 2009). Therefore, developing a regional network would improve the regional capacity to mitigate animal health problems by reinforcing and harmonizing animal health surveillance and control measures in all the countries of the region. The Caribbean Animal Health Network (CaribVET) is a collaboration network involving veterinary services, laboratories, research institutes, and regional/international organizations to improve animal and veterinary public health in all the countries and/or territories of the Caribbean by using agreed common approaches to information sharing, capacity building and adoption of collective codes of operation. The global objectives of this regional network are to improve the regional sanitary situation, to promote commercial exchanges in the region and to protect human health when animal diseases are transmissible to humans. The specific objectives are to:

- Support the development of a regional strategy as regards animal health in country/territory members
- Contribute to the structuring, the reinforcement and the harmonization of the national animal health surveillance networks.
- Improve and harmonize the control of animal diseases and implement an early alert system at national levels;
- Reinforce the technical skills of the main actors of surveillance networks and support the development of adapted tools necessary for surveillance and control of animal diseases, including diagnostic capacity and information systems;
- Improve the knowledge on animal diseases and their distribution in the region and promote notification to the OIE.

This paper describes recent advances in CaribVET and especially the adoption of a charter which is considered to be a major step in the network development as it seeks to deliver a more coherent and coordinated set of initiatives to strengthen the surveillance capacities of its membership. The Charter is visioned to enable CaribVET to strengthen its foundation for garnering more technical and financial resources for providing more technical interaction among members, providing

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information on the network, and for the recognition by all the participant countries and by international organizations. These factors all lead to the sustainability of this regional network.

Materials and methods

CaribVET started more than a decade ago by technical activities on classical swine fever, ticks and tick-borne diseases, West Nile virus, and salmonellosis, by meetings, training workshops, and dissemination of information on the CaribVET website (www.caribvet.net). CaribVET gained wider recognition as serving the needs of the Region in the strengthening of animal health surveillance and capacity. In 2006, the real benefits of such a network were heightened by the world wide focus on Avian Influenza. CVOs from throughout the Caribbean agreed to a reinforced membership and enabled the endorsement of its use by the economic union - the Caribbean Community (CARICOM) [Gongora *et al*., 2008]. Since 2006, a design incorporating common structures for decision-making, coordination and collaboration was chosen to reinforce the coherence, effectiveness and sustainability of CaribVET. It includes:

- A Steering Committee composed in 2010 of CVOs of 31 participating Caribbean countries/territories (Figure 1) and representatives of regional/international organizations, research institutes and universities operating in the Caribbean: CARICOM, CIRAD, USDA, FAO, OIE, IICA, PAHO, UG, UWI, CENSA.
- A Coordination Unit comprising Caribbean experts in epidemiology, in animal health and in management in the Caribbean region. The Coordination Unit is currently composed of the chairperson and co-chair of the CaribVET steering committee, CIRAD Guadeloupe, USDA/APHIS-IS (Dominican Republic office) and the CARICOM Secretariat.
- Technical working groups that are both disease specific: “Avian Influenza”, “Classical Swine Fever”, “Ticks and Tick-Borne Diseases”, “Salmonellosis” “Rabies”; and transversal: “Epidemiology” and “Quality assurance and Laboratory”.

The network has been funded since1995 thanks to specific projects funded by FAO, USDA, CIRAD, Guadeloupe region, IICA, French Minister of Foreign Affairs, European Union. In 2010, the activities of the network are being mainly funded by Interreg IV Caraïbes CaribVET (funded by CIRAD, Europe and Guadeloupe region), and the VEP Project (funded by USDA and organization/institutions: CIRAD, IICA). Caribbean countries and territories also fully support and financially participate in CaribVET activities and meetings.

The CaribVET charter was prepared by the coordination unit and the chairperson of CaribVET. After review by members, the charter was adopted at the 5th steering committee in May 2010. After validation of the last version, the charter was signed late 2010 by the CVOs and other members.

Figure 1: Countries and territories of CaribVET: CARICOM countries (Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St Lucia, St Kitts and Nevis, St Vincent and the Grenadines, Suriname, Trinidad and Tobago) ; CARICOM Associate Members (Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Turk and Caicos) ; non CARICOM countries (Cuba, Dominican Republic, US territories -Puerto Rico, U.S Virgin islands-, French territories -Guadeloupe, French Guyana, Martinique-, Dutch territories -Aruba, Bonaire, Curacao, St Maarten-).

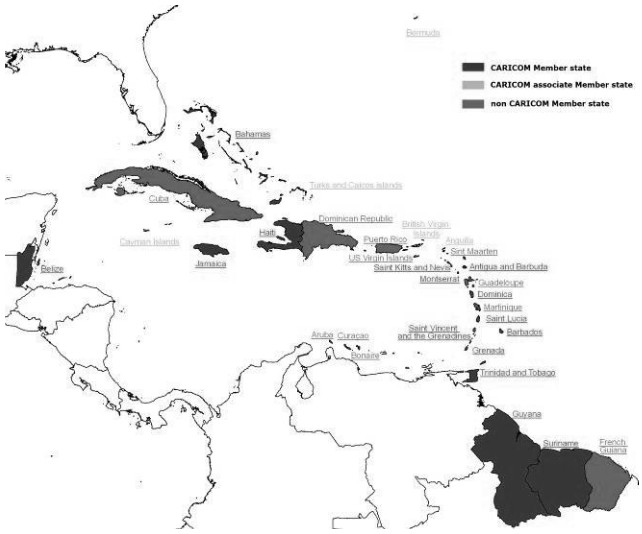
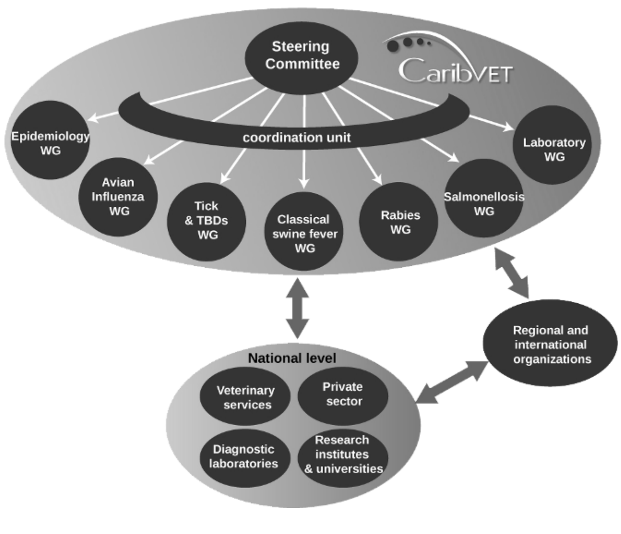


Figure 2: Organogram of CaribVET



Result

The CaribVET charter defines the network and its global and specific objectives. It describes the global organization of the network (steering committee, coordination unit and technical working groups), defines the members of CaribVET who are influential leaders and experts in the Caribbean working in the field of animal health, the relationship between the regional network and national networks, the latter benefiting from the services and support provided by the former.

The charter defines the composition, chairmanship, terms of reference, operation and rules of CaribVET steering committee, coordination unit and technical working groups

The objectives of the steering committee are to determine the main orientations of CaribVET and the list of regional priority diseases; define regional strategies and priority actions concerning animal disease surveillance, and, possibly, control; make recommendations for strengthening national and regional surveillance and response mechanisms and systems; and periodically assess the usefulness and relevance of the organization of CaribVET in meeting the animal health surveillance needs of the Caribbean countries and territories.

The coordination unit facilitates the operation of the network and the communication among the members, provides scientific expertise and also provides a link with research activities.

Working groups gather Caribbean specialists who have recognized competence and/or experience in the thematic areas targeted by the network. The working groups carry out specific activities that can be mandated by the Steering Committee. Activities are then reported to the Steering Committee and proposed for comments and adoption. The charter indicates that the working groups can request specific information or data from CaribVET members if they are necessary to conduct their activities.

The charter also explains that communication and data exchange among members of the regional network is a key element to meet the objectives of CaribVET. It includes meetings, training sessions, missions of experts and the CaribVET interactive and participative website (http://www.caribvet.net). Information can be posted on the website by members of the network. In order to guarantee the confidentiality and reliability of information, the charter specifies that only CVOs or someone designated by the CVO can add country specific sanitary information on the website.

The charter further describes the rules for data exchange and properties. Sanitary data and information are the property of the CVO of the country and territory they originate from. The regional network is dedicated to exchange and communicate data for national networks' benefit. Nevertheless, the regional network, CaribVET, does not substitute the World Animal Health Organization (OIE). The notification of listed animal diseases to the OIE is a country's official responsibility and the CVOs of each country are encouraged by CaribVET to comply with their international obligations.

Discussion

For the last 10 years CaribVET has proven to be an efficient operation in terms of organization of meetings and trainings, development of epidemiological tools, databases, and surveillance protocols. The CaribVET network and its organization allow interactions between surveillance, research and policy formulation. This strategy of creating a link between an institutional network (official veterinary services and a technical network (scientists, epidemiologists), allows the definition of research questions in conformity with regional strategies and surveillance and health issues. It also provides access to surveillance data and field samples for the development of research studies and eventually improves the quality of surveillance and associate tools. Overall, this should increase the level of notification to the OIE by the countries.

After a first recognition as the Caribbean animal health network in 2006, increased number of activities and interactions within and outside the network made it necessary to formally describe the network and its operation. This formalization came as a result of many years of operation and technical activities (bottom up process) and was a request from the country members. This has been accomplished thanks to the charter (described in this paper) that is fully adopted by CaribVET members.

By its content, the charter facilitates the understanding and the adoption of the objectives and operations of the network by all the members. It increases the trust between the members since it describes in particular the data management properties. It provides to partners and to regional and international organizations clear information on the network, prevents any conflict, avoids duplication of technical activities in the region and therefore facilitates the development of cooperation agreements. The signature of the charter by all the CVOs and representatives of regional and international organizations, universities and research institutes provide a higher strength to its content and demonstrate its value for its full adoption. One of the ultimate goals of the charter is to provide a clear document to the decision makers in the countries and territories to demonstrate the need for political support of supranational animal health networks, and to the funding agencies to promote the network and its sustainable funding. It is expected that the charter will evolve taking into consideration the needs of the Caribbean region related to animal health surveillance and control.

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Acknowledgements

We wish to thank all CaribVET members for their active participation. This work was cofunded by Fond européen de développement régional- FEDER, Interreg IV Caraïbe "CaribVET"

Assessment of the Avian Influenza H5N1 surveillance system for backyard and free-range poultry production systems in Thailand

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Abstract

For infectious diseases, as highly pathogenic avian influenza virus H5N1 (A/H5N1 HP), the need for an early detection and warning mechanism is essential, especially when countries have been free of disease for an extended period of time. Evaluating the sensitivity and the expected cost of surveillance are necessary steps to ensure an efficient and sustainable system. Stochastic scenario tree modeling has been used here to assess the sensitivity of the A/H5N1 HP surveillance system in sector IV of Thailand. The whole process of disease detection, from passive surveillance to X-Ray, has been described and sensitivity of each component and of the overall system has been estimated. Scenarios, according to selection of high risk areas, inclusion of components or sampling procedure, have been tested and discussed.

Keywords: Surveillance, Evaluation, Scenario tree modeling, H5N1, Thailand.

Introduction

Since its emergence in Hong Kong in 2003, the highly pathogenic avian influenza virus H5N1 (A/H5N1 HP) has spread in several countries of the Southern East Asian region, being responsible for culling of millions of poultry and death of hundreds human beings. Currently, the disease is considered as endemic in some of these countries (Cambodia, Vietnam, China). In contrast, Thailand which was seriously affected by the epidemics in 2003- 2004, managed to control the disease and declared its last outbreak in 2008 [1].

Since the first wave of the epidemics, the poultry surveillance system in Thailand has been continuously modified [2]. The Department of Livestock Development (DLD, Ministry of Agriculture and Cooperatives, Bangkok, Thailand) is the unit in charge of A/H5N1 HP surveillance and control. At the start of the epidemic, intensive active surveillance (X-Ray) was used with 800,000 volunteers visiting every single farm to look for clinical signs of HPAI and to take samples on poultry [3]. As the number of outbreaks decreased, the surveillance design was modified to focus on risky areas [4].

In the present situation, high sensitivity of the Thai surveillance system is crucial, in order to detect from the onset, any new incursion of the disease and to prevent the spread of the virus in a large proportion of the poultry population. However, given the endemic situation of A/H5N1 HP in neighboring countries, surveillance needs as well to be sustainable and cost-effective. In this work, we used a scenario tree approach to evaluate the sensitivity of the current national A/H5N1 HP surveillance system applied to the sector IV of poultry production (backyard and free-range systems) in Thailand. Each component of the system was evaluated and several scenarios of surveillance system were discussed. This should allow proposing recommendations for cost-effective surveillance systems.

Methods

We used a stochastic scenario tree model [5] to estimate the probability that the surveillance system will detect the disease if present at certain prevalence. The scenario tree is representing the whole process of disease detection, including all the factors influencing the probability that a random selected animal is infected and detected. We assumed that the surveillance has perfect specificity. The overall sensitivity was computed for a specific period of one month.

To consider uncertainty and variability of our input parameters, we used probability distributions. Each component of the surveillance system was described and we used @RISK5.5® (Palisade Corporation) with Microsoft® Excel 2007 to estimate their sensitivity using a Latin Hypercube sampling with 10,000 iterations and an initial seed chosen randomly.

Reference population: Data on poultry farm population was provided by the DLD, from the 2005 census database. The reference population was backyard farms (3,431,203 farms) and free-grazing duck farms (12,122 farms), as categorized in the DLD census. For each scenario, the number of farms per sub-district (SD) was computed. According to the National Statistic Office (NSO), 72,335 villages located in 7,410 SD are recorded in Thailand. Islands were removed for the analysis as we assumed that they played a minor role in disease distribution. This resulted in a geo-database of 7,366 SD. High risk areas (where targeted active surveillance was carried out) were defined at the SD level, according to the DLD regulation. High risk areas were SD where at least one HPAI H5N1 outbreak was laboratory-confirmed from 23 January 2004 to 5 May 2005 (zoning 1), according to the DLD outbreaks database.

Surveillance System Components (SSC): The passive surveillance is made of 2 SSC, declaration of any A/H5N1 HP suspicion by the backyard owners (SSC1) and by the free-grazing ducks farms owners (SSC2). These components operate all along the year.

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The active surveillance or X-Ray, is made of 3 components. Two of them are covering every village with backyard poultry owners in high risk areas, with the first one being based on the active search for clinical cases matching the DLD case-definition (SSC3) and the second one based on virological samples (SSC4) with a pooled cloacal swab of 5 birds for each farm. The last component is a virological survey in every free-grazing ducks farms in the country (SSC5) with 4 pooled cloacal swabs of 5 birds from each farm. X-Ray runs over a month period and twice a year.

Setting up of model parameters: Each event of the surveillance process is represented in the scenario tree as a node (infection, detection and category nodes). For the infection nodes, which represent the design prevalence (*e.g.* the predetermined threshold of prevalence that the system aims at detecting once the disease has been introduced), we used four levels: animal status (P*a), farm/flock status (P*f), village status (P*v) and sub-district status (P*sd). In order for the overall surveillance system (SS) to detect at least 3.5 or 1 sub-district if the disease was present, we set the P*sd at 0.05% and 0.014% respectively.

The detection nodes are the steps leading to detection of the infection. For the X-Ray, there is a single detection node which is the sensitivity of the diagnostic test (Se_t) used at the central veterinary laboratory. For passive surveillance (Figure 1), we have three additional nodes, the probability to have noticeable clinical signs (Pcs), the probability that farmers will report the problem to DLD staff (Pdld) and the probability that DLD will send a team to collect samples (Ps).

The category nodes are dividing the population under surveillance in several groups for which the probability of being infected or detected is the same. For each branch, we need to know the proportion of each category and to assign a relative risk (RR) to the risk of infection or detection. These risks are adjusted to a reference population for which the average risk is one. In our model we have two types of infection category nodes. First one, the risk area categories, defined as high and low risk areas (RR=1). Second one, the type of farm categories, defined as free-grazing farms, mixed backyard farms (with ducks and chicken) and chicken farms (RR=1).

Surveillance scenarios: To be able to compare the current surveillance system sensitivity (SSe) to alternative surveillance, we generated several scenarios (Table 1). We selected other risk areas based on two different criteria. The zoning two, where high risk areas are defined by SD with free-grazing farms, and the zoning three where high risk areas are defined by SD with a relative risk significantly >1, in accordance with the model published in Paul *et al.* [6]. Then each scenario that is described in Table 1, was assembled in relation to SSC and zoning. We also compared the current system according to different case-definitions and different sampling procedures (number of pooled cloacal swabs) used over time.

Figure 1: Passive surveillance components SSC1 & SSC2

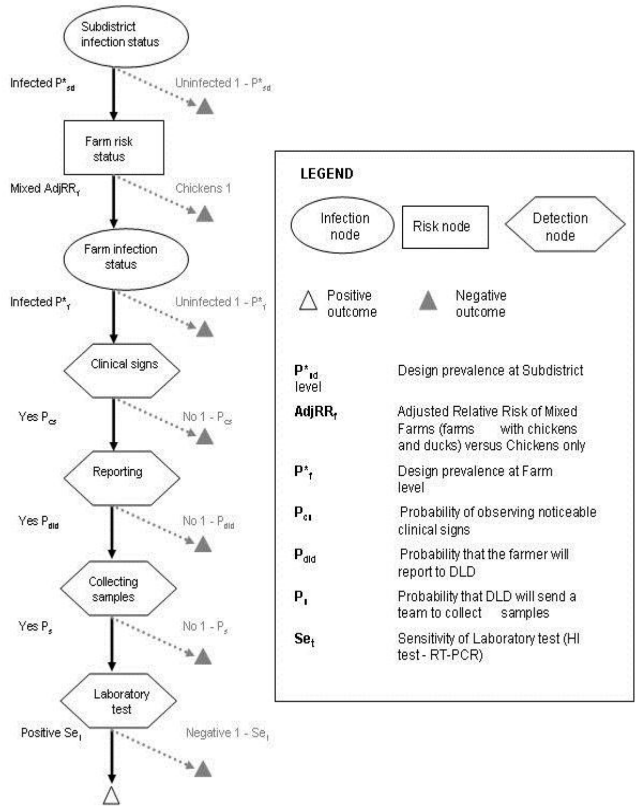

Table 1: Structure of the different scenarios

	SSC 1	SSC 2	SSC 3	SSC 4	SSC 5
Scenario 1 - All SD	X	X			
Scenario 2 - Zoning 1	X	X	X	X	
Scenario 3 - Zoning 1	X	X	X		
Scenario 4 - Zoning 1	X	X		X	X
Scenario 5 - All SD	X	X			X

Results

Sensitivity of each SSC of the current surveillance system has been calculated. The SSC5, laboratory surveillance on free-grazing farms, is contributing the most to the overall Se of the system with a mean component sensibility (CSe5) of 96% ($CI_{90\%}$ 0.889-0.975). CSe5 is the same whatever the sample procedure, there is no change in the CSe between 4 pooled cloacal samples or 12.

The SSe of the current surveillance system, is evaluated at 99% ($CI_{90\%}$ 0.9964-1), for P*sd=0.05 (detection of at least 3.5 SD) and at 94% ($CI_{90\%}$ 0.8669-0.9830) for P*sd=0.014 (detection of at least 1 SD). Table 2 shows that, for the current composition of the system, the zoning 3 has the best overall sensitivity for both design prevalence.

Between the five scenarios, the fourth and the fifth have the best overall SSe for P*sd=0.05 and only the fourth one has a good SSe for P*sd=0.014.

Exclusive passive surveillance (scenario 1) will bring the poorest SSe1 for the overall system with SSe of 76% ($CI_{90\%}$ 0.2777-0.9732) for P*sd=0.05.

Table 2: Overall sensitivity of the surveillance system (SSe), according to zoning and scenarios

	P*sd (%)	SSe Mean	IC5	IC95
Current system zoning 1	**0.05**	**0.99**	**0.9984**	**1**
	0.014	**0.94**	**0.8669**	**0.9830**
Current system zoning 2	0.05	0.99	0.9964	1
	0.014	0.90	0.8335	0.9502
Current system zoning 3	0.05	0.99	0.9991	1
	0.014	0.95	0.8867	0.9863
Scenario 1	0.05	0.76	0.2777	0.9732
	0.014	0.39	0.0887	0.6365
Scenario 2	0.05	0.97	0.9032	0.9983
	0.014	0.84	0.6582	0.9536
Scenario 3	0.05	0.93	0.7643	0.9930
	0.014	0.56	0.3307	0.7505
Scenario 4	0.05	0.99	0.9891	0.9998
	0.014	0.91	0.8138	0.9750
Scenario 5	0.05	0.99	0.9735	0.9993
	0.014	0.77	0.6389	0.8666

P*sd: Design Prevalence at sub-district (SD) level

Discussion

During the two months of the year when the 3 components of X-Ray are actually implemented, the SSe of the overall system is good. The surveillance will be able to detect the presence of the disease in one SD (that at the very onset of the outbreak) with a probability of 94% and with a probability of 99% for 3.5 SD (when the disease will have already spread but at containable extent). But the method that we used in our model assumes that the components of our surveillance system are independent, which is not the case if we consider passive surveillance. So we might have overestimated the SSe. Further analysis taking into account lack of independence and overlapping between systems will be performed.

The specific time of X-Ray has been selected according to risk factors of disease introduction in Thailand: period of past outbreaks occurrence or of increase of poultry movement (Chinese New Year period), when the probability of new outbreaks emergence are high. Outside X-Ray period, only passive surveillance is implemented, and in our model the SSe of this scenario (Scenario 1) for the detection of at least 3.5 SD is low 76% ($CI_{90\%}$ 0.2777-0.9732). This small effectiveness could result from different reasons. First, the high level of uncertainty of the data we used to estimate model parameters, especially that of the distribution used to estimate probability of detection and reporting by farmers [7], could result in an underestimation of the SSe of passive surveillance. However, it's recognized that surveillance based only on clinical signs and deliberate declarations may have a poor sensitivity with high variability, in relation to level of farmers knowledge, seriousness of disease and types of enforcement measures (with or without compensation). In the case of A/H5N1 HP in Thailand, the control measures based on the massive culling of poultry population in infected farms and in farms within 1 km radius with only partial compensation may have discouraged farmers from reporting the disease to DLD.

The zoning selection seems to have a limited effect on SSe for the detection of at least 3.5 SD. But when we are comparing the zoning effect, in relation to the cost of active surveillance, the number of samples processed, it appears that the current zoning, which includes only 894 SD, should cost twice less than the zoning 2 and three time less than the third one. Moreover, the transition from 12 pooled cloacal samples to 4 pooled cloacal samples has no impact on the SSe of the current system, surely saving budget on laboratory expenses. When comparing the 5 possible scenarios, the last scenario combining passive surveillance and laboratory surveillance on free-grazing ducks comes out as the most cost-effective option, showing a high SSe of 99% ($CI_{90\%}$ 0.9735-0.9998), and a substantial reduction of the number of samples to be processed.

This model allowed comparison of several scenarios for surveillance of HPAI outbreaks in the open-range systems of poultry production. A negative predictive value (*i.e.* the confidence that one can have in disease freedom), could be calculated from the last outbreak in Thailand until now. This would allow taking into consideration temporal discounting of the ongoing surveillance.

Other types of surveillance (wild bird surveillance, surveillance in broiler farms), which are not described in this model, could also be included as they currently contribute to increasing the sensitivity of the overall system.

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Acknowledgements

This study was carried out in the framework of the ANR-funded ANR 06SEST12, ECOFLU project and under the PHC program. We warmly thank the Department of Livestock Development to have allowed us to develop this work. We also thank Dr Sirichai Wongnarkpet for his valuable support.

An innovative means of establishing a national epidemio-surveillance network in Afghanistan

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Summary
This report describes the pilot introduction of a novel system for establishing an epidemio-surveillance network in seven Provinces of Afghanistan during the late spring of 2010 (Figure 1). During this pilot introduction, 131 Veterinary Field Unit (VFU) veterinary para-professionals ("paravets") were contracted under a Sanitary Mandate contracting scheme to first report suspected cases or outbreaks of notifiable diseases and then, when requested by their supervising Provincial Veterinary Epidemiology Officer (PVEO), to conduct an Outbreak Investigation. The results of the pilot scheme have been very promising. During the 3 month trial period (June-August 2010), 551 Disease Report Forms (DRF), 463 Outbreak Investigation Forms (OIF) and 538 Laboratory Submission Forms (LSF) were completed although only 221 laboratory samples for the confirmation of suspected cases or outbreaks, based on clinical suspicion, were submitted to the nearest Provincial Veterinary Authority and onwards to the Epidemiology Department and Central Veterinary Diagnostic &Research Laboratory. A preliminary analysis of the Disease Report and Outbreak Investigation Forms submitted by contracted veterinary para-professionals suggests that many of these persons may be mistakenly arriving at a definitive diagnosis when this is not necessarily always possible or appropriate. Thus many of the laboratory samples submitted were not appropriate for confirmation of diagnosis. In the Discussion we provide some ideas on how a different approach to the training of para-professionals on the differential diagnosis of important notifiable diseases and laboratory sample selection may help to overcome this problem.

Keywords: Epidemio-surveillance, Sanitary mandate contract, Veterinary para-professionals.

Introduction

The Directorate of Animal Health, within the General Directorate of Animal Health & Production, Ministry of Agriculture, Irrigation & Livestock, Kabul is undergoing a process of structural and functional reform with assistance of the European Union funded, Animal Health Development Programme (AHDP).

Amongst the many other interventions, the reform process involves the establishment of a new Department of Epidemiology and, as one of its priority functions, the development of a functional national epidemio-surveillance network.

Afghanistan is unusual in that it already has just over 1000 privately operating veterinary para-professionals, known as "paravets", providing routine clinical and preventive veterinary services throughout the most important livestock rearing areas of the country, under the professional supervision and support of Non-Governmental Organisation (NGO) employed qualified veterinarians. These paravets work from a small simple premises or Veterinary Field Unit (VFU) consisting of an office, a store and a place to examine animals. Paravets are livestock keepers who have been selected by members of their local community as being well respected, trusted and successful farmers. The selected candidates are provided with a preliminary six-month practical skills oriented course in clinical examination, history taking, disease diagnosis, and the treatment of common diseases using medicines safely and correctly. The training they receive is based upon utilizing their existing and often extensive knowledge of animal health and signs of sickness or ill health. They are also trained in the handling and use of animal vaccines and when to use these against the most common diseases for which vaccination is appropriate in Afghanistan.

On the other hand, the Veterinary Authority (VA) is desperately short of either professional or para-professional officers deployed in the field below the Provincial capital level and for this reason a policy decision has been made to engage private sector service providers to assist the VA to perform some of its core functions in the field, through a public/private partnership.

Recently, and as a means of initiating a process of engagement between provincial government Veterinary Authority officers and private sector service providers, the Directorate of Animal Health has established a Department of Monitoring, Evaluation & Coordination of VFUs. The aim of this Department is not only to monitor the quality of services offered by the animal health service providers and to measure client satisfaction, it is also to develop a relationship with the service providers with the intention of building the public/private partnership whereby the VA enters into a contractual relationship with private vets and paravets to undertake certain public functions on behalf of the state veterinary service under a "Sanitary Mandate"

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contracting scheme. Provincial Veterinary Monitoring Officers (PVMOs), who also play an important role in helping to manage the sanitary mandate contracting scheme at the local level, are being trained to perform these functions.

The sanitary mandate contracts to perform specified services on behalf of the VA are now being used to establish a network of vets and paravets who are contracted to report suspected cases or outbreaks of a list of prioritized (OIE listed) notifiable diseases based upon clinical suspicion, and then, when so requested, to perform a follow-up outbreak investigation which involves the collection and submission of appropriate laboratory samples to the nearest Provincial and/or Regional veterinary diagnostic laboratory for processing and, where possible, testing. The Provincial or Regional Veterinary Laboratory officer is then responsible for processing and forwarding the samples to the Central Veterinary Diagnostic Laboratory (CVDRL) (National Reference Laboratory) for confirmation of diagnosis.

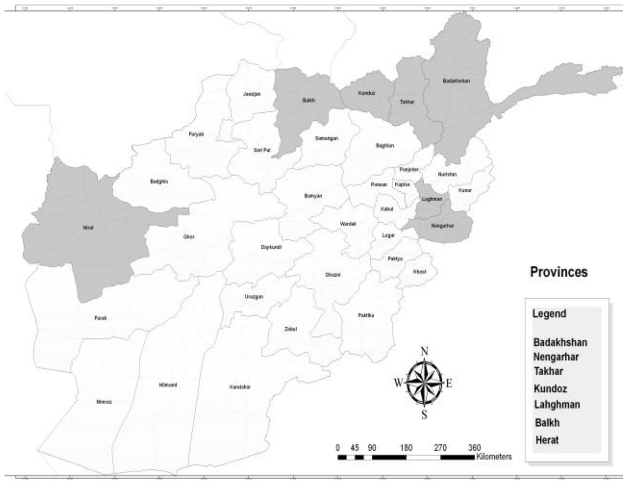
Materials and methods

Practical training of private vets, paravets, NGOs and Provincial Veterinary Authority personnel

Before awarding a sanitary mandate contract to any private vet or paravet, groups of vets and paravets were selected on the basis of their geographical distribution and provided with two consecutive training courses. In the first of these the trainees were given refresher training on the epidemiology and differential diagnosis of 16 prioritised notifiable diseases which are common in Afghanistan. The training was given by an NGO (The Dutch Committee for Afghanistan (DCA)) which has many years of experience in providing this type of training to veterinary para-professionals as well as veterinary graduates. Trainees not only learn the most important presenting signs of the listed diseases, they were taught how to collect and handle the most appropriate samples for laboratory submission. The second training focused more on the organizational aspects of the sanitary mandate contracting scheme, including the chain of reporting which links the disease event on the farm to the database of the Epidemiology Department at the Central headquarters of the VA, and explained the rules for acceptance of DRFs and OIFs, logistics for submission of forms and samples, and how payment claims would be verified before payments would be made.

A separate series of short training sessions was given to NGO veterinary supervisors, PVMOs, PVEOs and PVLOs, working in each of the seven selected provinces of Badakhshan, Balkh, Herat, Kunduz, Laghman, Nangahar and Takhar. This training included refresher training on the completion of the standardized reporting forms, so that supervisors could assist paravets having difficulty in completing the respective forms correctly, and, in the case of the Provincial Veterinary Authority personnel, how to decide when to perform an outbreak investigation themselves and when it might be appropriate to request the paravet to perform this service under his or her sanitary mandate contract license. In the case of the PVLOs, the training focused on handling of laboratory samples, performance of certain tests such as the diagnosis of Anthrax through examination of direct blood smears stained with Methylene Blue and, and how to process and forward samples for tests which could not be performed at the local provincial laboratory level to the CVDRL.

Figure 1: Map of Afghanistan showing the seven selected Provinces for this trial



The disease reporting and outbreak investigation system relies upon the fact that a livestock keeper will report the occurrence of an unusually high level of morbidity or mortality or other disease occurrence, such as a case of abortion, to his local private vet or paravet. The vet or paravet then visits the farm, and carries out a preliminary investigation. If he concludes that it is likely that what he is seeing is one of the prioritized listed notifiable diseases (or indeed any other notifiable disease), he then reports immediately by mobile phone to the nearest PVEO. The vet or paravet may then be requested by the PVEO to continue to the next stage of the specified services defined in his sanitary mandate contract and conduct an Outbreak Investigation. If the PVEO decides it is necessary for himself to conduct the outbreak investigation, then the reporting vet / paravet will complete a preliminary Disease Report Form (DRF). Either way, when an outbreak investigation is carried out by either a private vet or paravet or the PVEO, an Outbreak Investigation Form (OIF) is also completed, a necropsy may be performed, in which case a Necropsy Report Form (NRF) is completed, the appropriate samples are collected and an LSF completed all of which are then immediately delivered to the nearest Provincial Veterinary Office and handed to the Provincial Laboratory Officer (PVLO).

Implementation of the pilot epidemio-surveillance sanitary mandate contracting scheme

131 paravets working from VFUs in each of the 7 selected Provinces were awarded a 3-month contract. Each contracted paravet received quadruplicate copies of the 4 standardised reporting forms (DRF, OIF, NRF and LSF) as well as laboratory sampling equipment, including bijou bottles containing glycerin buffered

saline for collection and submission of FMD samples. In order to remain within a finite budget proposed for this pilot exercise, paravets were restricted to report no more than 5 suspected notifiable disease events each month for a total of 3 months. Furthermore, paravets were limited to a maximum of 5 outbreak investigations, depending on whether or not they were requested to undertake these by the PVEO. Where paravets were not requested to perform an outbreak investigation, the PVEOs undertook these themselves. Fees were paid to paravets after DRFs and OIFs had been verified independently by the respective PVMO. PVEOs and PVMOs were additionally paid allowances to undertake some outbreak investigations and spot checks on a sample of outbreak investigations in order to verify the occurrence of the reported disease event and to ensure that services were being performed in conformity with the Terms of Reference of the sanitary mandate contract. NGO employed supervising veterinarians were contracted separately to supervise and assist the paravets when completing the standard reporting forms and conducting outbreak investigations.

Results

During the 3 month period of this trial a total of 551 suspected cases or outbreaks of notifiable diseases were reported and all DRFs have been completed and transmitted to the nearest respective PVEO. On the basis of these reports a total of 463 outbreak investigations were carried out during which 63 necropsies were performed and 538 LSFs were completed. However, only 221 laboratory samples were recorded as having been received at the CVDRL. Of this total of 221, 98 samples (44.3%) were from animals suspected of being infected with Foot and Mouth Disease (FMD). 81 submissions (36.6%) reported the occurrence of “Sudden death” which was attributed to suspected Anthrax.

Discussion

Although the quality of data provided on the various forms which were submitted is not yet up to the required standard, we believe that the results of this trial are very encouraging. There is probably a need for PVEOs to be more selective in allowing outbreak investigations to proceed only when these are really necessary, since a number of the reports did not necessarily warrant the performance of an outbreak investigation.

A preliminary analysis of the report forms submitted provides some interesting information. For instance, the interpretation of “Sudden Death” as being attributed to suspected cases of Anthrax. Of the 81 samples submitted to the CVDRL for confirmation of suspected Anthrax none was positive. This suggests that paravets tend to jump to the conclusion that Anthrax is the only cause of sudden death. However, in the case of suspected cases of FMD, where the presenting clinical signs are almost pathognomonic, we are confident that the clinical suspicion of FMD is likely to be accurate since it is less likely to be confused with any other disease.

In examining many other of the DRFs, OIFs and LSFs submitted, similar mistakes regarding presumptive diagnosis are evident. Thus, in many cases, inappropriate or an insufficient range of laboratory samples were submitted for laboratory confirmation of diagnosis. We therefore propose to re-orientate the refresher training given to the vets and paravets who have been engaged to assist with establishing a national epidemio-surveillance network in Afghanistan. It is proposed that instead of teaching trainees how to diagnose diseases on the basis of learning the presenting signs and gross pathological lesions for each of the listed diseases as a single disease entity, we shall focus our training more on the basis of recognizing “clinical entities” as illustrated in Table 1 below. Each clinical entity can have a number of possible causes, some of which may be one or other of the listed notifiable diseases. For each clinical entity, trainees will then be trained to consider which diseases they should include in a list of differential diagnoses. In this way we hope that a more appropriate range of diagnostic samples will be submitted to the CVDRL. Thus, it is also hoped that, in the future, we will more likely be able to arrive at a definitive diagnosis based upon laboratory findings.

Table 1: Examples of Clinical entities, differential diagnoses and appropriate laboratory samples

Clinical entity	**Differential Diagnosis**	**Laboratory samples**
Sudden Death	Anthrax, Pasteurellosis (HS), Clostridial diseases, Bacterial septicaemias, *etc.*	Blood smear, whole blood, lung, spleen, long bone marrow, intestinal contents
Nervous signs	Rabies, hypomagnesaemia, (BSE), Coenurosis,	Complete head, Serum, plasma samples, *etc.*
Respiratory signs	CCPP, Broncho-pneumonia, Lungworm infection, Pasteurella pneumonia, *etc.*	Lung tissue, bronchial swabs, faecal samples, pleural swabs *etc.*

Acknowledgements

The authors would like to thank the Delegation of the European Union for their generous financial support to the implementation of this trial. The authors acknowledge the enthusiastic cooperation of the many private vets, paravets and State Veterinarians who collaborated in the performance of this trial.

Community Animal Health Workers (CAHW) Can Serve as Livestock Disease Surveillance Agents in a Resource Poor Environment in Southern Sudan

M.P.O. Baumann[1], T. Schuster[2], M. Otto[2] and W. Dühnen[3]

Abstract

The potential of community animal health workers for livestock disease surveillance in a Southern Sudan county has been positively assessed and can be propagated.

Keywords: Community Animal Health Worker, CAHW, Disease Surveillance Agent, Southern Sudan.

Introduction

During the civil war in Southern Sudan, community based animal health workers (CAHW) trained, established and maintained through member organizations of Vétérinaires Sans Frontières Europa (VSF Suisse, Belgium, Germany in their respective operational areas) as of 1998 had been the only reliable animal health services delivery entry points to the livestock producing communities. CAHW concentrated on cattle vaccinations, *i.e.* Rinderpest, anthrax, black quarter and the like. After the Comprehensive Peace Agreement (CPA) has been signed in 2005 and non-governmental organisations became active all over Southern Sudan the transition of the CAHW system as an emergency animal health delivery system into a veterinary delivery system in the rural and remote areas dealing with livestock disease control and surveillance is to be tackled. Thus, a shift from relief to development work in the livestock sector is more than overdue [1]. In order to prepare the grounds achievements, activities and capacities of this veterinary cadre within a project context need to be known and quantified.

In the VSF Germany led Recovery and Rehabilitation of Gogrial East County (RRP) Project, Warrap State, we evaluated the potential of CAHWs for animal disease surveillance in the field by describing quantitatively and qualitatively achievements, shortcomings and challenges of the CAHW system.

Materials and methods

The approach taken includes a follow-up analysis of CAHW trained before project start in 2006 and the qualitative and quantitative analysis of regular project data as far as available and retrievable for this purpose. A first assessment of CAHW resources and activities was done in 2007 and complemented by a second work-up in 2009 on the availability, performance and capacity of the CAHW working with the RRP Project.

The majority of the human populations of Gogrial East County (with its 6 administrative sub-units *payam*) are livestock producers from the Dinka tribe keeping predominantly cattle and to a lesser extent sheep and goats.

There is seasonal migration to the *toic* (dry season grazing areas, seasonally flooded by Nile tributaries) with an estimated total of 600,000 cattle grazing in the *toic* between December and May.

Activity statuses of CAHW were recorded each time the CAHW contacted the Veterinary Component of the Project whereby returned drug revenues and new vaccine and veterinary drug distribution allowed for treatment and vaccination recording. In doing so temporal and spatial pattern of livestock diseases could be determined and related to the individual CAHW; respective trends are then graphically displayed.

Eventually, the livestock disease treatment delivery capacity [2] was calculated and the descriptive statistics for treatments administered by a single CAHW, first by livestock species individually and then summarised for all livestock served over the years, given. This may serve as a proxy for the animal health surveillance potential of the CAHW system in Gogrial County, Warrap State, Southern Sudan.

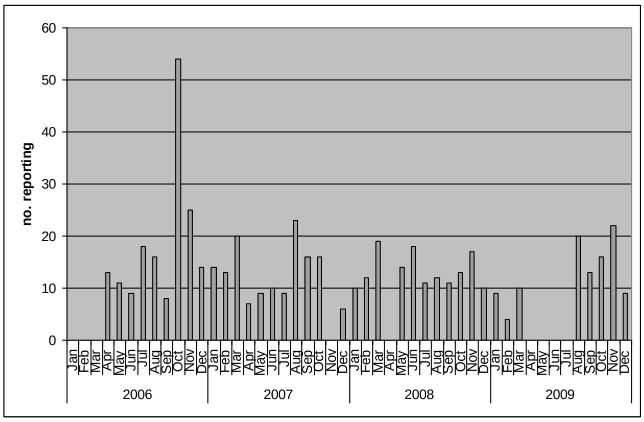
Result

A prerequisite for any disease control and surveillance activity is the availability (Table 1) and reporting activity of the CAHW over time (Figure 2)

Table 1: Veterinary auxiliary staff active in Gogrial East County, Southern Sudan during 1998 and after the Comprehensive Peace Agreement in 2005

	1998	2005	2007	2009
CAHW	116		56	45
AHA (Animal Health Assistant)	7	Comprehensive Peace Agreement (CPA)	5	4
Small Stock Attendant	-		32	4

Figure 1: Number CAHW reporting over time, April 2006 - December 2009, in Gogrial East County, Southern Sudan



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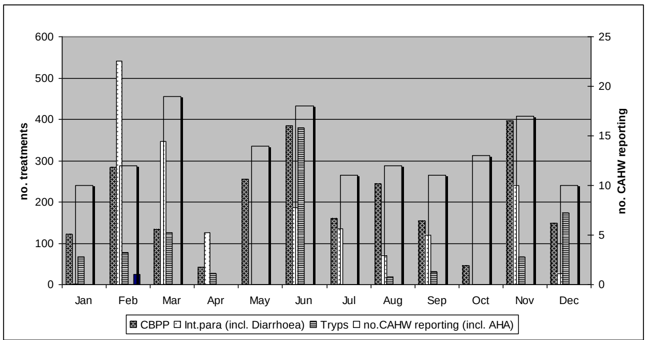
There is a relatively constant though limited number of active CAHW, however, covering over the year most of the county's area (Table 2)

Table 2: CAHW activities and coverage during 2008 and 2009 by month in Gogrial East County, Southern Sudan

	2008			2009		
	no. CAHW reporting	no. villages/ locations /herds	no. *pay-ams*	no. CAHW reporting	no. villages/ locations /herds	no. *pay-ams*
Jan	10	6	3	9	6	3
Feb	12			4	3	3
Mar	19			10	5	4
Apr						
May	14	5				
Jun	18	8	5			
Jul	11	8	3			
Aug	12	7	3	20	15	5
Sep	11	7	3	13	10	5
Oct	13	6	2	16	14	5
Nov	17	10	4	22	17	6
Dec	10	6	3	9	8	6

In taking advantage of the CAHW reporting cattle disease treatments - - as an example - - were broken down by month (as recording unit) and presented against the number of CAHW reporting (Figure 2).

Figure 2: Selected cattle disease treatments over 2008 by CAHW by month in Gogrial East County, Southern Sudan



In general treatments were high in numbers but mainly due to external parasite (ticks, mange) treatments after the onset of the rainy season in June; internal cattle parasites had the greatest share of treatments particularly in February at the height and again towards the end of dry season (May/June).

Infectious disease trends in cattle over time become apparent for CBPP and trypanosomosis, at least partly explained by seasonality (rainy season) and movement pattern (migration from villages to *toic* and back); confounding factors certainly include the tight security situation in the project area in 2008 as well as drug supply.

CAHW activities can also add valuable information with regards to small ruminant disease surveillance (Figure 3).

With the start of the rainy season in 2008 the number of herder requested internal parasite treatments in sheep and goats increased. Clearly in Figure 3, the usefulness of CAHW not only for animal health services delivery but also for disease surveillance becomes apparent: the steep increase of PPR with the rains as well as the wave of `CCPP´ (often used as synonymous for any pneumonia observed) are prominent and call for further intervention and control.

Figure 3: Selected CAHW treated small ruminant diseases in 2008 in Gogrial East County, Southern Sudan

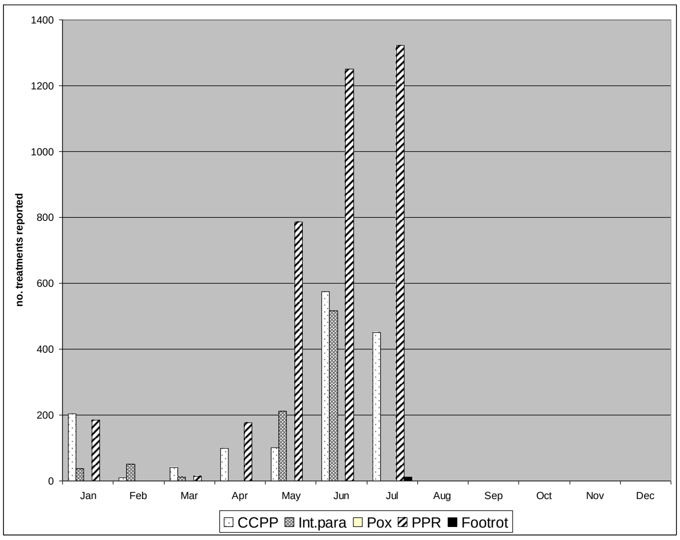


Table 3: Descriptive statistics for calculated livestock treatments per day administered by a single CAHW

Species	Para-meter	2007 (N=11 month)	2008 (N = 11 months	2009 (N = 8 months)
Cattle	Mean	2.6	2.9	1.7
	Median	2.5	2.4	1.4
	Mini-mum	0.7 in May	0.3 in Oct.	0.4 in Feb.
	Maxi-mum	5.2 in Dec.	7.1 in June	3.5 in Oct.
Sheep & goats	Mean	2.5	4.3	3.2
	Median	2.1	2.7	3.3
	Mini-mum	0.8 in Jan.	0.7 in March	1.2 in Sept.
	Maxi-mum	8.2 in Sept.	12.7 in Oct.	6.5 in Jan.
Overall	Mean	5.2	7.2	4.9
	Median	4.9	6.4	5.2
	Mini-mum	1.6 in May	3.0 in March	2.4 in Dec.
	Maxi-mum	11.7 in Sept.	13.5 in July	7.2 in Oct.

Variations in daily CAHW working activity between the years as well as in different months over the years become apparent. Whether this is biased due to the fact that treatment patterns are seasonal and /or attributed to drug and vaccine availability remains to be determined.

Discussion

The detailed insight into the community based animal health delivery system in the project areas of Gogrial East County allows not only the analysis of the curative and preventive veterinary activities but also an assessment of the animal health situation over time. Hence, disease treatments as demanded by the livestock herders and reported by the CAHW reflect disease occurrence and, thus, provides highly valuable disease monitoring and surveillance information.

In this remote area where no government veterinary service exists at all surveillance capacity and potential is further determined by the number of herds/flocks accessible in order to reach at an acceptable livestock population coverage. Furthermore, it would have been desirable to relate the number of cases reported for a given disease to the population at risk. However, due to unreliable or non-existing livestock census data for the project area this was not possible at all, thus, population-based risk measures (such as disease prevalence and incidence rates) could not be calculated.

Despite these limitations CAHW as an essential part of this animal health services delivery system do have the potential to act as surveillance agents and provide crucial livestock disease information. To fill the pertinent existing information gaps on animal health information from the field the Ministry of Animal Resources and Fisheries of the Government of Southern Sudan should take greater advantage and promote this approach further.

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Acknowledgements

The authors would like to acknowledge the support provided by the RRP Gogrial East Project, Warrap State, Southern Sudan, and the Regional Office of VSF Germany, Nairobi, Kenya.

Establishment of Heartwater surveillance in an enzootic situation: Example in Guadeloupe, French West Indies.

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Abstract

The surveillance of heartwater, a disease of ruminants transmitted by *Amblyomma variegatum* tick, was established in Guadeloupe in 2010 after the recommendations of the Ticks and tick-borne diseases working group of CaribVET, the Caribbean Animal Health Network. This surveillance was designed and settled considering the epidemiological situation in Guadeloupe *ie*. high tick infestation and high prevalence of heartwater.

The network involving farmers, private veterinarians, vet services, farmer association (GDSG) and CIRAD relies on the report of suspected cases by farmers to the field veterinarian, on the report of this case to the veterinary services, on the molecular diagnostic test for tick transmitted tropical diseases to assess the etiology and on the subsequent farmer sensitization in case of heartwater positive detection in the neighborhood. An online database was developed to allow data centralization and the real time restitution of the surveillance results on a map.

The main objective of the network is to monitor the diseases of ruminants in Guadeloupe associated with nervous symptoms and better know the importance of heartwater in such clinical signs, and to describe disease distribution. Most of all, this network aims at strengthening the collaboration and interconnection of every stakeholders in the field and improve farmers knowledge dealing with the disease and its vector biology, which is a key element for the success of tick control campaigns.

Keywords: animal health surveillance, cattle, Guadeloupe, heartwater, *Amblyomma* tick.

Introduction

Guadeloupe is a small archipelago (60 km width) located in the Caribbean region with numerous cattle holdings and a long past of heartwater infection, a bacterial disease caused by *Ehrlichia ruminantium.* This pathogen is transmitted by *Amblyomma variegatum,* a tick species also called Tropical Bont Tick widely distributed on the islands. In Guadeloupe, cattle is highly infested by the tick (40% of infestation on average) and the tick infection by *E. ruminantium* is also very high (more than10%) [Molia *et al.,* 2008].

Guadeloupe archipelago and a neighboring island, Antigua, are the only areas known to be infected by heartwater in the Americas. Furthermore, given their high level of Tropical Bont Tick infestation in these islands, they represent a reservoir for vector spread in the Region. The tick vector is also present in several other islands of the Lesser Antilles [Vachiery *et al.*, 2008] despite an extensive programme which was developed between 1995 and 2006 to eradicate the tropical Bont tick from English speaking islands of lesser Antilles [Ahoussou and coll, 2010].

In October 2009, during the first Tick and Tick Borne Diseases working group meeting held in Fort Collins (Colorado) under the hospices of CaribVET, the Caribbean animal health network, it was recognized that surveillance strategies for ticks and heartwater should be adapted to the different epidemiological situations namely: areas free of the vector (group 1), areas with low Tropical Bont Tick infestation (group 2); area with medium infestation (group 3) and finally places with heartwater (group 4 *i.e.* Antigua & Guadeloupe). It was recommended in particular to develop a surveillance programme for heartwater in countries with limited surveillance for the vector.

From November 2009 to July 2010, meetings were organized with the different stakeholders in Guadeloupe in order to set up the surveillance of heartwater and include this surveillance in a broader programme of surveillance of neurological diseases. The primary objective of the network is to monitor the nervous symptoms of ruminants in Guadeloupe. The name of the network, RESPANG, was derived from the acronym of the objective in French (REseau de Surveillance des Pathologies Nerveuses en Guadeloupe).

Secondary objectives are enhancing the diagnosis of heartwater based on clinical signs, reinforcing the links between cattle farmers and field veterinarians, sensitizing farmers to the consequences of tick infestation and to tick control.

The methodology, protocol and preliminary results are presented hereafter.

Materials and methods

The protocol was designed according to the methodology developed by Dufour *and coll* [2009].

The network targets registered cattle and small ruminants. A case was defined as follows: ruminant presenting noticeable modification of general condition (depression, anorexia, hair modification) or constipation and nervous symptoms (behavior change, lack of motor coordination, pedaling, tremors, ...) or a sudden death. Based on this suspicion, a visit by private veterinarian is completed. Call-out fee are paid by the vet services. Treatment is paid by the farmer. A questionnaire is filled and animals are blood sampled.

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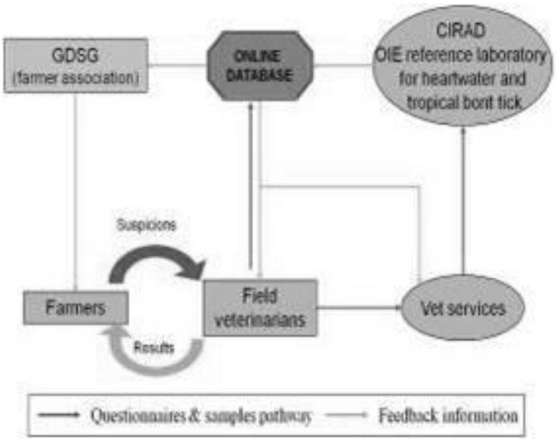
4 Association des Vétérinaires Praticiens d'Exercice Liberal, AVPLG, Baie Mahault, Guadeloupe

Sample batches are sent every two weeks at CIRAD Guadeloupe, the OIE reference laboratory for heartwater, for *Ehrlichia ruminantium* detection [nested PCR targeted on pcs20, Molia *et al.*, 2008]. Babesiosis (*Babesia bovis* and *Babesia bigemina*) and anaplasmosis (*Anaplasma marginale* and *Anaplasma ovis*) are also searched by PCR.

Results are regularly sent to the veterinary services. In case of heartwater positive results the veterinary services inform the Groupement de Défense Sanitaire (GDS), a farmer association, of the location of the confirmed cases. Then, the GDS is in charge of organizing meetings with farmers in the neighborhood located near heartwater cases to provide farmers with disease epidemiology and efficient tick control information. Didactic leaflets were developed by the GDS together with Vet services and CIRAD to target and improve communication with farmers.

Figure 1: Organization of the network and information flowchart



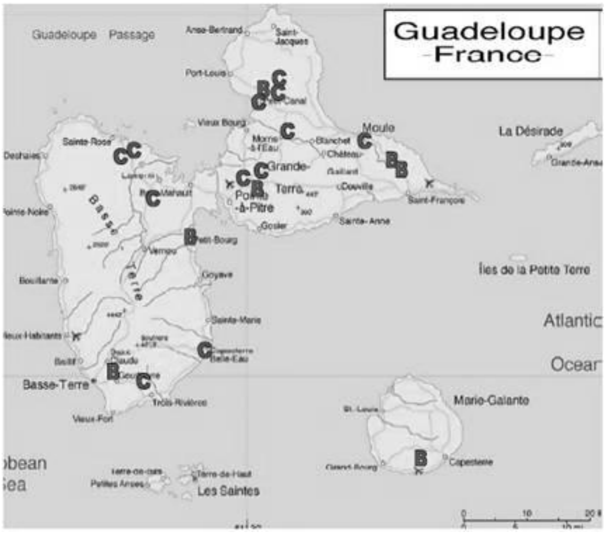
An online database was developed at CIRAD to centralize data collected in the field. Each stakeholder (veterinarian, veterinary services, GDS, CIRAD) access the database with different rights, according to their function in the network. Veterinarians enter data related to farm location, individual information, clinical signs and suspicion, herd management and tick control. CIRAD enters the diagnostic results and the veterinary services are in charge of the data validation. Results and information can be exported into .csv file and maps of location of samples and results are created automatically and provided for each stakeholder.

Results

RESPANG was officially launched on July 2010. The technical committee met on September 2010 in order to adapt the protocol to field conditions. The questionnaire was partly modified and after a validation stage of the database with every actor, it is available online since December 2010.

After nearly about 4 months of operation, on the 6th of December, 65 suspicions have been notified by veterinarians and 53 samples were tested for heartwater, 46 for babesiosis and anaplasmosis. Twenty nine samples were tested positive for heartwater, 20 for babesiosis (13 for *Babesia bovis*, 6 for *Babesia bigemina*, and 1 for both species). Thirteen coinfection heartwater/babesiosis were identified. Fourteen samples were negative for both diseases. All samples were negative for anaplasmosis.

Figure 2: Output example: location of confirmed cases of heartwater (C) or babesiosis (B)



Discussion

The implementation of this network provides benefit to each of the stakeholders. At the field level, it reinforces the links between farmers, private veterinarians, veterinary services and diagnostic laboratory. It also produces a better knowledge of impact and distribution of the different tick transmitted diseases (heartwater, babesiosis, anaplasmosis) in the archipelago. Results of a sociological survey conducted in Guadeloupe to better understand the reluctance of several farmers to adopt efficient treatment against ticks will be associated to the RESPANG feedbacks to increase farmer awareness on heartwater consequences and prevention measures.

At the scientific level, this network allows the collection of new *Ehrlichia ruminantium* strains from field samples which will be used for study of structuration of *Ehrlichia ruminantium* at regional level and will help to develop regional vaccines. Eventually, this surveillance network could also help to design epidemiological studies to understand disease transmission and criteria for disease installation.

At the regional level, the estimation of the evolution of heartwater circulation in Guadeloupe is a key element to start risk analysis of heartwater introduction in other islands and in the America.

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Enhancement of Especially Dangerous Pathogen Surveillance in Uzbekistan: Development of a Sustainable Training Program

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Abstract

We describe the delivery of a training program in Uzbekistan to enhance the country's surveillance capabilities against especially dangerous pathogens. The program delivers basic field, epidemiology, and laboratory skills to a large number of officials involved in veterinary surveillance. The program promotes the overarching improvement of general proficiency and awareness among surveillance stakeholders over very specific training objectives.

Keywords: especially dangerous pathogens, surveillance, training delivery.

Introduction

A key element of the success of any disease surveillance program is the availability of skilled field personnel who have local knowledge of the animal populations of interest. Knowledge of field epidemiology and disease control methods are essential components of this local workforce's skill set. Equally critical for the effective delivery of surveillance is the local availability of laboratory specialists that ensures staffing of regional networks of diagnostic laboratories, particularly in settings with limited geographical mobility. This is characteristic of Uzbekistan (UZ).

As part of a comprehensive effort to enhance the surveillance of Especially Dangerous Pathogens (EDP) in UZ [1], the Defense Threat Reduction Agency (DTRA, US Department of Defense), through its Biological Threat Reduction Program (BTRP), places a strong interest in training local officials involved in the delivery of surveillance, particularly in the fields of laboratory diagnostics, epidemiology, biosecurity, and biosafety of EDPs. The following are high priority EDPs in UZ: foot-and-mouth disease, anthrax, rinderpest, classical swine fever, notifiable avian influenza, Newcastle disease, brucellosis, glanders, and poxviruses.

Training a local workforce to meet the increasing demands of new laboratory methodologies and ensure skilled and established field veterinary services requires prolonged and sustained investment. To this end, DTRA has supported the Government of UZ (GoU) since 2003. Although BTRP comprises both human and veterinary EDPs, and thus provides training to public health and veterinary officials, this paper focuses on the training provided to officials within the Ministry of Agriculture and Water Resources (MoAWR), which is responsible for the delivery of veterinary surveillance in UZ.

Training design

The core of the training is consistent across all the countries of the former Soviet Union where BTRP operates and is designed to support BTRP goals, in particular the enhancement of processes leading to prompt detection, identification, and reporting of animal EDP-caused diseases. Training materials are commissioned by DTRA and distributed to all BTRP participating countries. At the host country, a series of in-house processes follows the receipt of materials: review, acceptance by DTRA and, finally, translation into Russian. The review process aims to assess the adequacy and alignment of the training materials within the host country setting, in particular whether the equipment described during the training is available and whether the practices and processes meet the host country requirements. Inconsistencies in those two areas are corrected and reported to the author (course material developer) and to DTRA. In UZ, translation of materials is done locally by two certified Russian translators.

Overall, the program delivers well over 500 hours of formal training, of which 100 hours cover field training, epidemiology and surveillance approaches. Laboratory-specific materials constitute the bulk of the training, with approximately 400 hours. The remainder of the program delivers on strategic decision-making and computer & IT systems.

The veterinary curriculum consists of several modules, each comprising a number of courses targeted at different specialist groups within the MoAWR:

1. Field training to district veterinarians responsible for the initial visit to animal disease incidents reported by farmers. All district veterinarians (197 total) receive training on recognition of EDP diseases, on-farm investigation approaches, diagnostic tests (including use and interpretation of pen-side tests for FMD and NAI), postmortem examination of livestock and poultry, sampling, sample packaging and shipping, biosafety, farm biosecurity, and hazardous waste management.
2. Field, descriptive, and advance epidemiology to veterinary epidemiologists at the seventeen planned Regional Epidemiology Support Units (ESU) distributed throughout the country. These officials provide epidemiological support to investigations of EDP suspect cases reported by the district vets. All regional field epidemiologists (48 total) receive the same training courses as the

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district vets but with extended modules on epidemiology, on-farm investigation, and outbreak-scenario practicals. The most advanced courses, on observational epidemiological studies, are also planned for national-level officials with country-wide responsibilities. The training aims to provide skills to perform analysis of surveillance data at the regional and country level and to design, implement, and analyse observational studies.

3. Laboratory modules for laboratory personnel at the network of Regional Diagnostic Laboratories (RDLs) built or renovated by DTRA as part of BTRP in UZ [1]. Courses under these modules cover bacteriological, serological (ELISA), and molecular biological (real-time PCR) diagnostic techniques, biosafety and biosecurity and laboratory quality systems. Over 100 laboratory personnel, including heads of laboratories, heads of laboratory units (*e.g.* serology), and scientists within these units receive these modules.

Execution of training requires initial assessment of core competencies of all of the individuals through pre-training tests. Formal training comprises lectures, practicals and field exercises. Once the formal training is delivered, competency in the new subjects is assessed by post-training tests. Formal training is followed by "*On the Job Training,"* a short-term mentoring period consisting of practical training and exercises on site.

Training delivery

Current training materials were contributed by different providers commissioned by DTRA, for example the Centers for Disease Control and Prevention (CDC), and, most recently, the University of Illinois at Urbana-Champaign College of Veterinary Medicine (US).

Courses are mostly delivered by trained UZ specialists, employed by an US contractor. The local resources include scientists and an experienced former UZ veterinary official who provides baseline knowledge of existing veterinary structures and an active contact network within official circles. A small number of expat scientists contribute to specialized training and overall coordination of the scientific program.

Training delivery follows closely the start-up plan of RDLs and ESUs across UZ, so training efforts are concentrated on those regions with operational facilities. Of the 14 regions and 347 identified officials involved in EDP surveillance in UZ, no training has been yet delivered in five regions with 96 identified officials. In five other regions, 50% or more of the officials (155 total) received less than 50% of the training, and in the remaining four regions, over 75% of the officials (96 total) received 50% or more of the planned training modules. To date, the average delivery of formal training across all modules and targeted official groups is 26%.

Previously, training sessions were delivered on site by one or two trainers at the different RDLs and ESUs across the country. Following a request from the GoU, future training will be delivered in the capital city of Tashkent. This last arrangement adds logistical complexities and costs to the delivery of the training curriculum, due to travel and accommodation expenses of the trainees.

Sustainability

Parallel to the design and delivery of the training materials, a number of initiatives are planned and conducted simultaneously to ensure the sustainability of the program when DTRA stops the funding and deployment of foreign experts, currently planned for 2015. The "Training of Trainers" (ToT) program constitutes the main initiative and comprises two phases: i) initiation phase where a UZ education facility is designated by the GoU and ii) implementation phase where joint training is conducted by DTRA representatives and the Uzbek-designated institution (DI). During the initiation phase, a technical evaluation of the DI is conducted to assess their training needs. A memorandum of collaboration that details the form and delivery of future training is subsequently signed by the DI and the US integrating contractor. The ToT program will provide officially-recognized training and will therefore contribute to the continuous professional development of specialists involved in animal surveillance.

The program is also progressing toward the required regulatory framework and set of instructions that would guarantee the adherence by officials involved in EDP surveillance to a set of minimum standards. For example, these may include a defined list of skills required in every position or the minimum level of statistical analyses required at the different stages of the reporting chain (region, nation-wide).

Discussion

The BTRP-sponsored vet training is mainly designed to increase capabilities in field processes. In recognition of the importance of robust and systematic processes throughout the entire decision-making chain, the program now contemplates a new training module for decision makers within the MoAWR. This module would focus on strategic issues such as evaluation of surveillance systems, evidence-based policy, surveillance strategies, and international engagement. A number of options are considered at the moment to increase local engagement with this initiative. These may include the organization of a workshop led by the MoAWR and with invited international experts on EDPs.

The main objective of the BTRP vet program is to create a sustainable training curriculum implemented by local specialists by 2015. Although the program delivers state-of-the-art training on a number of very specific subjects, especially through its laboratory modules, the program's underlying goal is to create sustainable structures, through the ToT program, that support a culture of continuous professional development. On this note, suggestions of additional sustainable approaches to keep a motivated and informed workforce will be discussed with the MoAWR and other potential contributors (international organizations and professional associations). This may include the professional recognition of staff with special interests, the creation of professional branches to accommodate these interests, and formal recognition of scientific and managerial excellence within the surveillance structures. For the latter, training needs of middle managers in fields like quality assurance, process control, and project management will require discussion with the MoAWR to assess if the current pool of skills is adequate to support continuous improvement.

The evaluation of the overall contribution of training to improved EDP surveillance is not a trivial exercise due to the difficulties of controlling for confounding factors. Still, basic performance indicators can be populated at every stage of the training delivery chain. *Laboratory Readiness Drills* and *Practical Test Evaluation* exercises (Table 1), due to the large number of processes and stakeholders involved, are thought to provide an indication of the overall readiness of the surveillance system and test the impact of the training provided. Other formal approaches to qualitatively evaluate the level of training and provision of continuous education to veterinary services are also available, such as the World Organisation for Animal Health's (OIE) Tool for the Evaluation of Performance of Veterinary Services [2]. EDP-specific training efforts should formally contribute to UZ's general training capabilities as already assessed by the OIE.

Although initially restricted to government officials, the program recognizes the importance of increased awareness among non-governmental stakeholders, such as private veterinarians and industry in general, in the delivery of a timely and sensitive surveillance. Benefits from engaging with non-official stakeholders would go beyond EDP surveillance. The program contemplates regular contacts with other institutions already operating in UZ (*e.g.* FAO) to find common ground for collaboration.

Table 1: Training Activity Flow and Assessment

Activity Type	Purpose	Metrics
Pre-test	Assess existing knowledge of the subject	Test results (>70% threshold)
Training (presentation & practical)	Provide information on specific subject	Training completion data
Post-test	Assess knowledge transfer	Test results
On the job training/Mentoring *(practical)*	Provide supervision and oversight of practical implementation of knowledge from training activities in an operational laboratory setting	Observation reports and recommendations for individual scientists
Laboratory Readiness Drills	Phased drills of discrete segments of the EDP surveillance system followed by complete system challenge to identify gaps. 24 hour notice; no preparation or coaching permitted	Performance gaps identified in supply line, assay execution, field operations, biosafety, biosecurity, *etc*. Remediation recommendations, repair gap, re-drill until 100%.
Proficiency testing (not yet started) *(practical)*	Assess ability to identify blinded sample (sample provided by an independent proficiency firm or local institution)	Success/failure in identification
Practical Test Evaluation *(practical)*	Independent observers assess how a team of scientists responds to a simulated outbreak and their ability to diagnose and respond to this outbreak	Observation reports and recommendations completed by observers

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Capacity building as a main tool for improvement of Regional Animal Health Network

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Abstract

The Caribbean region is composed of many scattered and diverse islands that are highly heterogeneous in terms of size, sociodevelopment level, political status, culture, environment, animal production systems, *etc*. The regular occurrence of natural disasters and sudden environmental and anthropologic changes increase disparity between islands and make the Caribbean particularly sensitive to the emergence of diseases.

Globalization, trade, and animal and human movements increase the risk of disease circulation. Since the failure of veterinary services and surveillance activities in one country may threaten the whole region, a regional approach to building skills in surveillance and control of animal diseases in the Caribbean is essential. The Caribbean Animal Health Network, CaribVET[i], is a regional collaborative network involving veterinary services, laboratories, and research institutes in 32 countries/territories as well as numerous regional/international organizations. The objective of this network is to improve the animal health situation in the Caribbean. To reach that goal, CaribVET promotes the harmonization and reinforcement of animal disease surveillance and control activities in the Caribbean by organizing training sessions for professionals at different levels (field workers, veterinary services, laboratory technicians) to improve their technical and scientific skills. The capacity building implemented in the region focuses on disease knowledge and epidemiology, surveillance and control protocols, information and data flows, and diagnostic tests. To build an efficient and sustainable network of skills in the Caribbean, evaluations of activities related to disease surveillance and control, as well as personnel are performed at both national and regional levels.

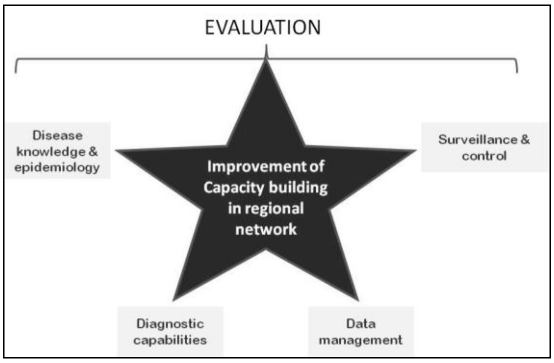
Keywords: epidemiology, training, surveillance network, Caribbean, animal health.

Introduction

The Caribbean region is constantly at risk of animal disease emergence and/or reemergence. The region is comprised of both developed and developing countries and/or territories which have important animal populations (cattle, poultry, swine and small ruminants). These populations are found in both backyard and industrial systems, with the resulting diversity in biosecurity practices. In addition, the formal and informal movement of humans, animals, and products of animal origin continues to increase, in part due to steady growth in the tourism industry, further exposing the region to pathogen introduction and spread. The disparities in the development level of countries/territories are reflected in the heterogeneity of countries´ veterinary services´ efficiency, funding level, and the surveillance and control activities conducted. These differences may be exacerbated by natural disasters and/or environmental, anthropologic or climatic changes, resulting in increased vulnerability.

A regional approach is needed to reinforce and harmonize the surveillance and control of animal diseases in every country / territory in the Caribbean. To this end, CaribVET was created in 2000. CaribVET aims to improve the regional animal health situation and to contribute to the harmonization and reinforcement of animal disease surveillance and control activities implemented at the national level[ii]. Capacity building can be seen as the foundation needed to meet these objectives. Within the regional network, human capacities are strengthened in countries/territories by focusing on key activities and domains (see Figure 1), which are essential for the efficiency and success of a professional network.

Figure 1: Domains of application for training and evaluation to build capacities in the Caribbean.
The efficiency of a network that deals with animal health issues relies on four key domains: diseases knowledge and epidemiology, surveillance and control activities, management of data, and diagnostics capabilities. Evaluations of these key domains identify current needs and the effectiveness of past training activities.



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Capacity building consists of 1) providing adequate training to key stakeholders who are involved or will be involved in a surveillance network and 2) ensuring that newly acquired or refreshed skills are appropriately used, through regular evaluation and, if needed, corrective action. The primary objective of this approach is to build a sustainable network of skills in each of these four domains in the Caribbean.

Materials and methods

To meet these objectives, the CaribVET steering committee, who defines annually the priorities of the network, has recommended various trainings. The CaribVET Coordination Unit, made up of Caribbean experts in epidemiology, animal health and management, works to ensure the coherence of the content of training activities, in collaboration with CaribVET working group leaders and funding institutions.

Projects supporting capacity building in CaribVET

Most of the training activities organized by CaribVET fall under two projects:

- INTERREG IV Caraïbes, funded by the European Union, Guadeloupe region and CIRAD from 2009-2011. While incorporating training and evaluation, this Interreg project aims to 1) reinforce the Caribbean animal health network; 2) improve and harmonize the surveillance and control of animal diseases, including zoonotic and emerging diseases; 3) implement an early alert system and 4) improve the knowledge on the distribution of the diseases in order to improve the regional animal health situation and to promote commercial exchanges within the Region.
- Veterinary Epidemiologist/Paraepidemiologist project (VEP project) funded by USDA since 2008. This project was initiated in countries which were involved in the former Caribbean Amblyomma Programme. The primary goals of the VEP project are to train specialists from the Caribbean in epidemiology and to develop and reinforce national animal health surveillance systems. Specific objectives are to: 1) establish an early detection and rapid response system in the Caribbean region for priority issues identified in the region, such as spread of the tropical bont tick and other tick-borne diseases, transboundary animal diseases, *etc*.; 2) encourage and support the use of databases for both national and regional surveys; 3) support the development of rapid national and regional emergency response task forces, and 4)strengthen the collaboration between stakeholders involved in animal health surveillance at both national and regional levels.

Evaluation of training needs

Although training needs may be directly expressed by the countries themselves, the evaluation of surveillance networks conducted by CaribVET with the Surveillance Network Assessment Tool (SNAT) has proven a very useful way to identify training needs. This tool was designed and implemented in 2006 by experts of the CaribVET Epidemiology working group (one of the 8 CaribVET technical working groups). Conducted in several Caribbean countries/territories each year on a voluntary basis, the application of the SNAT aims at help veterinary services identify gaps in their surveillance networks and determine priority actions to improve the efficiency of their surveillance activities. In addition, outcomes from application of the SNATs are analysed by the Epidemiology working group to identify common issues encountered by countries. This allows CaribVET to make regional recommendations for training based on nationally identified needs.

Performance indicators and trainings impacts

In order to follow the activities of the VEP participants and to assess the impacts of their training activities, a series of performance indicators, and an online performance evaluation system were developed. Project participants complete monthly a questionnaire over their activities for the previous month including: meetings and trainings attended or provided, communication with stakeholders and other participants in the surveillance network, samples collected for disease surveillance, participation in the development and review of surveillance and disease control protocols, review and updating of emergency response plans, *etc.* VEP participant activities are evaluated yearly to allow for the development of recommendations for the coming year.

Results

Since 2004, a number of trainings have been organized by CaribVET for the benefit of participating countries/territories. These trainings addressed the epidemiology of regional animal diseases, basic concepts in epidemiology, risk analysis, diagnostic test application and evaluation, data management, and the use of geographic information systems. The format of these trainings included workshops, lectures, conferences, table top and field simulation exercises, and mentorships.

Training on specific animal diseases

Training which specifically targets diseases of regional concern has been developed. For instance, in 2005, CIRAD-Guadeloupe developed a workshop over West Nile virus to address concerns over disease spread and advances made in the diagnosis of the virus. VEP project participants received training related to highly contagious diseases of swine through participation in field simulations in the Dominican Republic and on avian diseases via participation in a live bird market seminar series. In addition, some CaribVET working groups have organized their annual meeting to coincide with international conferences related to their frame of work. For example, the Avian Influenza working group met in 2010 during the Biennial Conference of the US National Poultry Improvement Plan. This allows the working groups members to stay current on disease-related scientific advances.

Training on basic concept in epidemiology
In order to strengthen the understanding and application of epidemiologic tools and principles in the region, the VEP project has developed numerous trainings. Beginning with a very introductory course over study design, data management, and diagnostic test evaluation, the VEP participants have been exposed to basic epidemiologic concepts in a variety of contexts, including endemic and foreign animal disease surveillance and emergency response activities. In order to encourage the application of these basic skills, participants were then paired with established epidemiologists who served as mentors for the design, implementation, and evaluation of an epidemiologic study. In addition to the VEP training program, USDA regularly funds the participation of motivated persons to attend trainings outside of the region such as the ICTAD meeting, which addressed topics related to diseases, epidemiology, and legislation.

Training on surveillance and control of animal diseases
In order to help veterinary services develop their own disease surveillance and control protocols, CaribVET Coordination Unit designed a guide which demonstrates the basic framework needed and the main items to be addressed. In addition, protocol drafts can be reviewed by experts from technical working groups upon request.

Strengthening diagnostic capacities
Work related to strengthening the diagnostic capacities in the region is ongoing. In 2009, 34 CARICOM laboratories located in 10 countries were visited and evaluated, and a final report was provided with recommendations for improvements. A regional database over laboratory characteristics was also created. Based on identified needs, trainings over specific methods were provided to laboratory staff in order to improve skills and familiarize staff with new diagnostic techniques. Several disease specific trainings have been conducted to address a variety of diseases such as Salmonellosis [Trinidad, 2000], and West Nile, avian influenza and tick-borne diseases (Guadeloupe, 2005, 2007 and 2010). In addition, laboratory staff were trained and certified on IATA procedures through a workshop in 2006, and through CD distance training in 2010.

Additionally, the quality of laboratory results have been evaluated in Cuba, Dominican Republic and Haiti through participation in an inter-laboratory assay organized by an OIE reference laboratory in Hanover, Germany for Classical Swine Fever diagnostics.

Hands-on experience
In order to move beyond theory, capacity building must also place participants in practical situations. To encourage application of basic concepts, numerous exercises have been conducted. A table-top exercise over Rift Valley Fever was held in US Virgin Islandsin 2010 to assess inter-agency communication, availability of resources and current emergency response plans. A series of field exercises were held in the Dominican Republic in 2009, 2010 in order to examine the investigation and trace-out of infected farms. In 2009, CIRAD-Guadeloupe organized an exercise to assess the ability of countries to collect and ship samples for avian influenza. The epidemiologic studies conducted by VEP participants are another example of hands-on learning opportunities employed within the region.

In addition to exercises, the working groups provide an important venue for the application of newly learned concepts. For example, the Epidemiology working group has worked on a territorial-based risk assessment database, several risk assessment studies, and a conceptual risk assessment framework for the region.

CaribVET website and communication
The CaribVET website[i] is both and information and communication tool for animal health stakeholders in the Caribbean. The overall format is updated once every 3 years, with technical content updated as needed. The website includes information on the animal health situation within the Caribbean and the Americas, past and future training events, as well as books and resources of interest. In addition, the website contains minutes, programmes, and slides of meetings from working groups, regional and international conferences, livestock data, and research activities. It also serves as a tool to share databases. Users can access the laboratory characteristics database, and will soon have access to an online declaration tool (which is first being tested at national level before application at a regional scale).

Most recently, the CaribVET information bulletin has been developed in order to provide updates on new tools, share results from participation in meeting/trainings, discuss upcoming events, and circulate information on a variety of topics related to animal health.

Discussion and conclusion
Although significant progress has been made in strengthening the four key domains for capacity building in the Caribbean, further work is needed. The performance indicators that were developed for the VEP project should be adapted to a regional scale in order to better assess the impact of capacity building activities funded by CaribVET.

In addition, results from the application of the SNAT in 13 countries to date, suggests that there continues to be a great need for trained epidemiologists who can design and conduct disease surveillance activities, respond effectively to disease outbreaks, and assist neighboring countries during a regional crisis. As these skills are strengthened within countries, continued communication and collaboration will be needed to ensure that highly trained individuals receive the resources and political support needed to address animal health concerns within their countries.

The establishment of CaribVET and the capacity building conducted to date represent important steps toward the sustainable improvement of animal health in the Caribbean.

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Acknowledgements

The authors thank CaribVET members for their active collaboration: Veterinary Services, laboratories, regional and international organizations, institutes and universities (CARICOM, CIRAD, USDA, FAO, OIE, IICA, PAHO, UG, UWI and CENSA). They also thank donor agencies for their funding support (European Union and USDA).

Policy Implications of Foot and Mouth Disease in Cambodia

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Summary
This paper reviews the current state of knowledge about foot and mouth disease in Cambodia; outlines disease control options and constraints; considers their policy implications; and identifies various practical steps to address present constraints.

Keywords: Foot and Mouth Disease; Cambodia.

Introduction

Foot and mouth disease (FMD) is a severe, highly communicable viral disease of cloven-hoofed animals, including cattle, buffalo, pigs, sheep and goats. Although most FMD outbreaks do not result in high mortality, the disease is debilitating and leads to significant economic losses from its impact on productivity and trade. Infected animals eat less and are less productive, with lower meat and milk yields and reduced draught capacity [1, 2, 3].

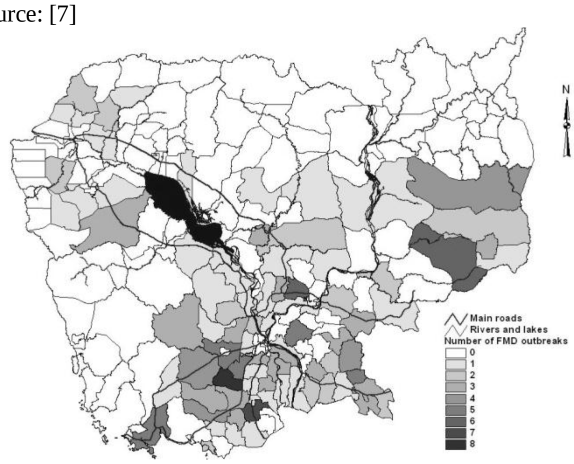
The disease can also be a major constraint on the use of cattle and buffalo for draft power and can cause severe losses in pigs [4], as well as financial losses through reduced production and productivity [1]. FMD outbreaks can also have significant adverse psychological effects on farmers induced by stress and loss of income [5, 6].

FMD in Cambodia

FMD in Cambodia is poorly documented because there have been few detailed studies. Little is known for certain about the sources of infection and the means of disease transmission and spread, which is a major constraint of disease control policy and strategy formulation. Furthermore, the real proportion of susceptible animals affected (the "prevalence" of the disease) has not been properly determined, and the number of samples collected and submitted to regional and world reference laboratories for virus isolation and sero-typing is relatively small compared with many other countries in the region, including Thailand, Lao, Vietnam, Malaysia.

Nevertheless, FMD is known to affect many thousands of cattle, buffalo and pigs each year in Cambodia and is responsible for substantial losses in livestock production and smallholder income. The purpose of this policy brief is to summarize the current state of knowledge about FMD in Cambodia and identify various knowledge gaps that need to be bridged for better disease control and enhanced animal production for greater food security.

Figure 1: Distribution of FMD outbreaks: 2005-9 - Data source: [7]



Mortality Rates
FMD related mortality rates are highly variable, ranging from 0-50%, depending on outbreak and species. Overall mortality rates for the past decade from 1999 to 2009 were: 0.87% for cattle; 1.86% for buffalo and 6.44% for pigs [8].

Prevalence
Mean prevalence rates for the period 2005-9 were: 2.11% for cattle; 10.48% for buffalo; and 2.16% for pigs; based on a limited sub-sample of outbreaks for which data were available [8].

Sero-types
It is important to know the sero-type of outbreaks vaccination purposes. Relatively few samples have been collected and submitted for independent sero-typing. The predominant virus serotype found in Cambodia between 1999 and 2001 was serotype O [9, 10]. Two distinct topo-types of serotype O occur in Cambodia: the South East Asia (SEA) and Pan-Asia topotypes. Serotype A was first identified in Cambodia in 2006. Serotype Asia 1 has only been reported once in an isolated outbreak in 1997.

Transmission
Most FMD outbreaks in Cambodia occur and spread through the movement of animals, only a small proportion of which are officially authorized. The main livestock movements are shown in Figure 2, derived from a recent international supported study [11], which reflects the trade in cattle and buffalo from and transit through Banteay Meanchey, Odor Meanchey, Siem Reap, Kampong Thom, Kampong Chnnang, Battambang, Kandal, Kampong Cham, Prey Veng, Svay Rieng, Kampong Speu, Takeo and Kampot Province, to Phnom Penh and Viet Nam.

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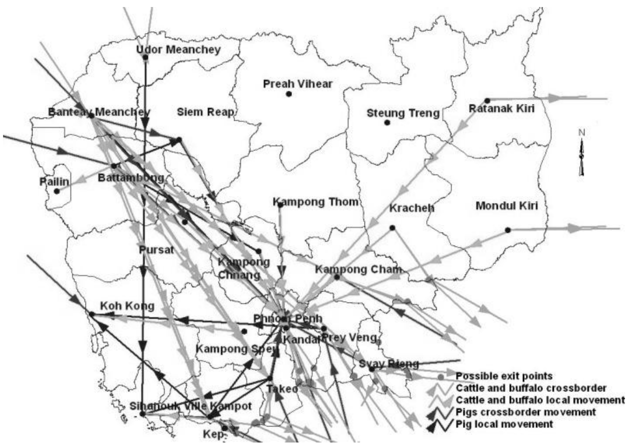
Before 2000, most of Cambodia's exported cattle and buffalo exported were sourced from within the country. The pattern of animal movement, however, has changed significantly over the past decade. The increasing demand and higher prices paid for cattle and buffalo in Viet Nam markets have encouraged the transit movement of live cattle through Cambodia from Thailand, in addition to cattle and buffalo exports from within Cambodia.

Figure 2 also indicates the importation of pigs from Viet Nam and Thailand to supply Phnom Penh and Siem Reap markets. Livestock movement is very loosely regulated in Cambodia, and is a major risk for the spread of FMD and other diseases from neighbouring countries.

Figure 2: Main flows of traded livestock - Source: [11]



Disease Control Options and Constraints

The main activities and options relating to FMD control are: surveillance; destruction of affected animals (also known as "stamping out"); vaccination; movement controls; and farmer and public awareness campaigns. Doing nothing is of course the default option, although international veterinary and trade agreements commit governments to various obligations that need to be addressed, including the reporting of notifiable diseases.

Field surveillance and disease control are weak in Cambodia, because of limited capacity to identify and classify animal health risks, and to collect and collate disease information required for realistic policy formulation and planning; and international reporting.

Recorded FMD outbreaks in Cambodia are likely to be under-reported due to: limited recognition of disease symptoms by farmers; lack of consultation with animal health workers at grass root level; and inadequate budget provision to facilitate disease investigations. Detailed epidemiological information necessary for disease control strategy formulation and effective implementation of control measures is, thus, lacking.

FMD outbreak control measures in Cambodia currently focus on restricting animal movements and disease awareness messages to farmers, due to the limited resources available for organised ring vaccination around outbreaks. Although the control of internal animal movements is obviously desirable, it is in reality very difficult to implement, and requires broader cooperation with neighboring countries to be effective.

Government's allocation for FMD vaccines is insufficient to cover even 20% of susceptible animals. Unless subsidised, vaccination is relatively expensive and beyond the means of most farmers. This is compounded by their limited understand of how vaccination works and its potential benefit.

The unofficial animal trade, especially of cattle and pigs, is another major constraint on effective implementation of disease control measures in Cambodia. An ordinance for controlling animal movement has been issued by the Ministry of Agriculture, Forestry and Fisheries (MAFF), but effective implementation with regard to cross-border trade has yet to be established.

A sub-decree on sanitary and phyto-sanitary (SPS) inspection and reporting, which complies with World Trade Organisation (WTO) requirements, has recently been issued and further strengthens the case for better monitoring and regulation of animals movements in Cambodia.

Policy Implications

More effective disease control to improve livestock production is one of various stated agricultural development objective of Government [12]. Capacity to formulate appropriate policy and implement control measures, however, is limited, both in terms of personnel and adequate information about animal resource distribution, disease reporting and monitoring of livestock movements, both with and through the country

Cambodia faces severe constraints in implementing an effective FMD control programme, many of which are common to neighbouring countries. At the moment, there is no accepted long term plan with assured funding to maintain a national FMD control programme. This uncertainty undermines confidence and continuity, and needs to be addressed as a matter of urgency.

Despite the constraints and uncertainties, some professional and institutional capacity does exist and is being strengthened, and the need for enhanced surveillance and the collection of more precise information on the nature and location of FMD outbreaks is recognized. This should preferably include geographical coordinates determined by a Geographical Positioning System (GPS) device, or failing that at least by commune and village name and ID number, as well as by province and district.

More detailed information is also required on the distribution and abundance of livestock and poultry resources in general, at least by district, and preferably by commune and village.

The spelling of geographical and administrative names is also inconsistent, both in Khmer and in English. To avoid continuing confusion and uncertainty about the location of disease outbreaks and the distribution of animal resources, all references to geographical and administrative names/locations, should be accompanied by their specific identification reference number or "geocode".

To facilitate the numerical identification process, serious consideration should be given to the development and use of standardized data entry software for animal production and disease records, at least at provincial level. The data gathered and entered into the database will facilitate more detailed analysis of the FMD situation and provide a sound foundation for developing a long term plan for FMD control.

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Acknowledgements

The authors are pleased to acknowledge the support of the FAO's Sub-regional Environmental Animal Health Management Initiative (EAHMI) for enhanced smallholder production in South-East Asia; and OIE's Southeast Asian Foot and Mouth Disease (SEAFMD) campaign; and in particular: Carolyn Benigno, FAO's Animal Health Officer in FAO's Regional Office for Asia and Pacific, Bangkok; and Raffaele Mattioli, Animal Health Office, FAO Headquarters, Rome.