Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Foreign Affairs FDFA

Swiss Agency for Development and Cooperation SDC
Humanitarian Aid and SHA

West Nile Virus and Costa Rica

Risk Assessment and Recommendations for Surveillance and Control

Joint Support Mission of the
Working Group Zoonotic Diseases
and
Medical Expert Group
Swiss Agency for Development and Cooperation

Costa Rica

26 February – 6 March 2009

Berne, May 2009

Index

1 Executive Summary

1.1 Summary

10 years after its introduction into New York and subsequent spread, West Nile Virus is widespread on the North American continent and has also been detected in Central America, the Caribbean, and some countries in South America. Its presence in Costa Rica is plausible yet unproven.
This uncertainty is of relevance with regards to human and animal (mainly cattle, horses, and birds) health. Adequate and efficient control strategies can only be implemented once this uncertainty is reduced or removed due to coordinated surveillance programs in different populations (humans, horses, wild birds, mosquitoes). In the meantime, disease awareness and education must be strengthened to address the issues of underreporting and misdiagnosis. Risk assessment (monitoring) and risk management (e.g., surveillance, control, communication) can and should leverage synergies with already ongoing activities in other areas (e.g., mosquito control for dengue, wild bird sampling for avian influenza).
Informal coordination between different stakeholders (human health and veterinary authorities, academia) is common practice, but an institutionalized approach, possibly coordinated by a new 'Costa Rican Centre for Emerging Zoonotic Diseases and Conservation Medicine', may not only enhance the effectiveness of disease control, but also add to Costa Rica's reputation as a nation contributing to the protection of global public goods and hence facilitate international financial support.

1.2 Recommendations

On diagnostic capacity:

- Establish diagnostic capacity for WNV, within one dedicated national reference laboratory, by providing reagents, primers, training, and proficiency testing, within an epidemiologic enhanced passive surveillance framework.
- Seek international support to ensure adequate levels of biosafety in a new and existing laboratory infrastructure.
- International contacts should be strengthened to ensure rapid confirmation of suspected outbreaks of disease/infection due to WNV Provide epidemiological feedback to health care providers.
- Ensure adequate feedback to clinicians submitting samples.

On human surveillance:

- West Nile fever in humans should become a notifiable disease, complemented by syndromic surveillance for encephalitis. WNV infection already is notifiable in animals.
- It is recommended that both passive and active surveillance strategies be adopted.
- Pending available diagnostic capacity and resources, determine the human seroprevalence of WNV infection in Costa Rica through representative, population-based sentinel sero-surveys.
- Pending available resources, test blood product and organ/tissue donations for WNV, in coordination with the national reference laboratory as soon as WNV has been detected in Costa Rica.

On veterinary surveillance:
- For equines, it is recommended that an enhanced passive surveillance be established based on the observation of neurological disease, and risk-based sentinel surveillance for detection of circulating arboviruses. The same risk-based sentinel sites could be used for vector surveillance.
- It is also recommended that enhanced passive surveillance of wild bird mortality be initiated.
- Further surveillance activities could be integrated into existing or planned research projects.

On vaccination strategy for horses:
- While there is no current justification for vaccination of horses against WNV in Costa Rica, we recommend that mechanisms be established for the rapid purchase of WN vaccine for use in horses should emergency vaccination be necessary in the event of an outbreak of WN disease in horses.

On vector surveillance and control:
- In the absence of any detectable WNV activity in the country, no specific recommendation is made with respect to vector surveillance and control for WNV infections. However, because of the close relationship between the WNV and Dengue virus, we recommend that the Dengue control program provide leadership and be cognizant of the risk of WNV for Costa Rica. Plans should be established for vector identification and control in anticipation of the arrival of WNV. Vector surveillance and control programs should be planned for both urban and rural areas where the species of mosquito vectors may differ.

On communication:
- Develop a joint (MinSa, SENASA, MAG) risk communication and education strategy.
- Establish risk-based communication to health care providers, veterinarians, animal owners and the community at large.
- Sensitize health care professionals and veterinarians for WNV differential diagnosis in the context of other neurological diseases.

On institutional arrangements:
- Establish a standing inter-institutional committee at the national level to coordinate the response to issues affecting both animal and human health.
- Consider creation of a consortium and corresponding center for the coordinated surveillance and control of zoonotic diseases in humans, production animals and wildlife.

General remark:
Although only WNV may be mentioned along the text, EEEV, WEEV, VEEV, and SLEV are always included implicitly unless stated otherwise.

2 Abbreviations

APHIS	Animal and Plant Health Inspection Service, www.aphis.usda.gov
BIREME	Virtual Health Library, PAHO, Brazil, www.bireme.br/php/index.php
BSL	Biosafety Level
CAREC	Caribbean Epidemiology Centre, www.carec.org
CDC	Centers for Disease Control and Prevention, United States www.cdc.gov
CEPIS	Virtual Health Library, PAHO, www.cepis.ops-oms.org/sde/ops-sde/bvsde.shtml
CFNI	Caribbean Food and Nutrition Institute, PAHO
CLAP/SMR	Centro Latinoamerico De Perinatologia/Salud De La Mujer Y Reproductiva, PAHO
CSF	Cerebrospinal fluid (Spanish LCR)
CT	Computed tomography
DHF	Dengue Hemorrhagic Fever
EEEV	Eastern Equine Encephalomyelitis-Virus
EEG	Electroencephalogram
EMG	Electromyogram
FAO	Food and Agriculture Organization of the United Nations
FETP	Field Epidemiology Training Program, CDC
HSV	Herpes simplex virus
ICGES	Instituto Conmemorativo Gorgas de Estudios de la Salud, Panama, www.gorgas.gob.pa
IHR	International Health Regulations, www.who.int/csr/ihr
IICA	Instituto Interamericano de Cooperatión para la Agricultura, www.iica.int
INBio	Instituto Nacional de Biodiversidad, Costa Rica, www.inbio.ac.cr
INCAP	Instituto de Nutrición de Centroamérica y Panamá, www.sica.int/incap
INCIENSA	Instituto Costarricense de Investigación y Enseñanza en Nutrición y Salud, www.inciensa.sa.cr
INS	Instituto Nacional de Salud, Bogotá, Colombia, http://www.ins.gov.co
IPK	Instituto Pedro Kourí, Cuba, http://www.ipk.sld.cu
IVI	Swiss Institute of Virology and Immunoprophylaxis
MAG	Ministerio de Agricultura y Ganadería (Ministry of Agriculture and Livestock), www.mag.go.cr
MinSa	Ministerio de Salud (Ministry of Health), www.ministeriodesalud.go.cr
MRI	magnetic resonance imaging
MTSS	Ministerio de Trabajo y Seguridad Social / Caja de la Seguridad Social, www.ministrabajo.go.cr
NCS	Nerve conduction studies
OIE	World Organization for Animal Health (Office international des epizooties); www.oie.int
OIRSA	Organismo Internacional Regional de Sanidad Agropecuaria, www.oirsa.org
PAHO	Pan-American Health Organization, www.paho.org
PANAFTOSA	Foot and Mouth Disease Centre, PAHO
PCR	Polymerase Chain Reaction
SDC	Swiss Agency for Development and Cooperation
SENASA	Servicio Nacional de Salud Animal Costa Rica, www.senasa.go.cr
SFVO	Swiss Federal Veterinary Office, www.bvet.admin.ch
SLEV	St. Louis Encephalitis-Virus
VEEV	Venezuelan Equine Encephalomyelitis-Virus
WEEV	Western Equine Encephalomyelitis-Virus

WHO	World Health Organization, www.who.int
WNV	West Nile Virus

3 Mission

The National Animal Health Service of Costa Rica (SENASA), reports to the Ministry of Agriculture and Husbandry (Ministerio de Agricultura y Ganaderia; MAG). It is the responsible agency for the surveillance and control of animal diseases including zoonoses in Costa Rica. Its Director General, Dr. Yayo Vicente, requested in writing the support of the Swiss Agency for Development and Cooperation (SDC) on June 30th, 2008, with respect to the evaluation of the situation of West Nile Virus in Costa Rica.

Purpose of mission and Terms of Reference

Following its introduction to North America in 1999, WNV has spread southward into the Caribbean Basin and Latin America where its public health impact remains poorly understood and surveillance systems are unprepared to track its spread. Previous to this mission, very little information was available on WNV in Costa Rica. Also, there was a lack of knowledge on other encephalitic diseases, i.e. Eastern Equine Encephalitis, Western Equine Encephalitis and Venezuelan Equine Encephalitis. All four diseases are OIE listed diseases and are zoonoses. All four diseases were suspected to be present in Costa Rica, but there were no or very scarce data on their occurrence and/or prevalence.

Tasks of the mission included:

- To assess the epidemiological situation of all four diseases in Costa Rica with a focus on West Nile Fever and support the setup of a valid functional surveillance program in order to protect animal and human health.
- To support SENASA with technical assistance in following fields:
  - Case definition for each of the four above mentioned diseases
  - Design of a study to detect the presence of these diseases in animals: which species should be sampled, which regions should be considered, at what time of the year sampling should take place, how many samples should be taken?
  - Development of an active risk-based surveillance program that covers birds, mammals and the different vectors
  - Evaluation of the diagnostic capacity in the laboratory
  - Evaluation of the contingency plan
  - Strengthen disease awareness of all stakeholders including the public in order to enhance surveillance capacity and reporting
  - Strengthen the human- veterinarian relationship (Vet. Service with Ministry of Health) with regard to the zoonotic and epidemic potential of these viruses.
  - Development of an information plan of WNF, EEE, VEE and WEE.

The mission team consisted of 5 experts:

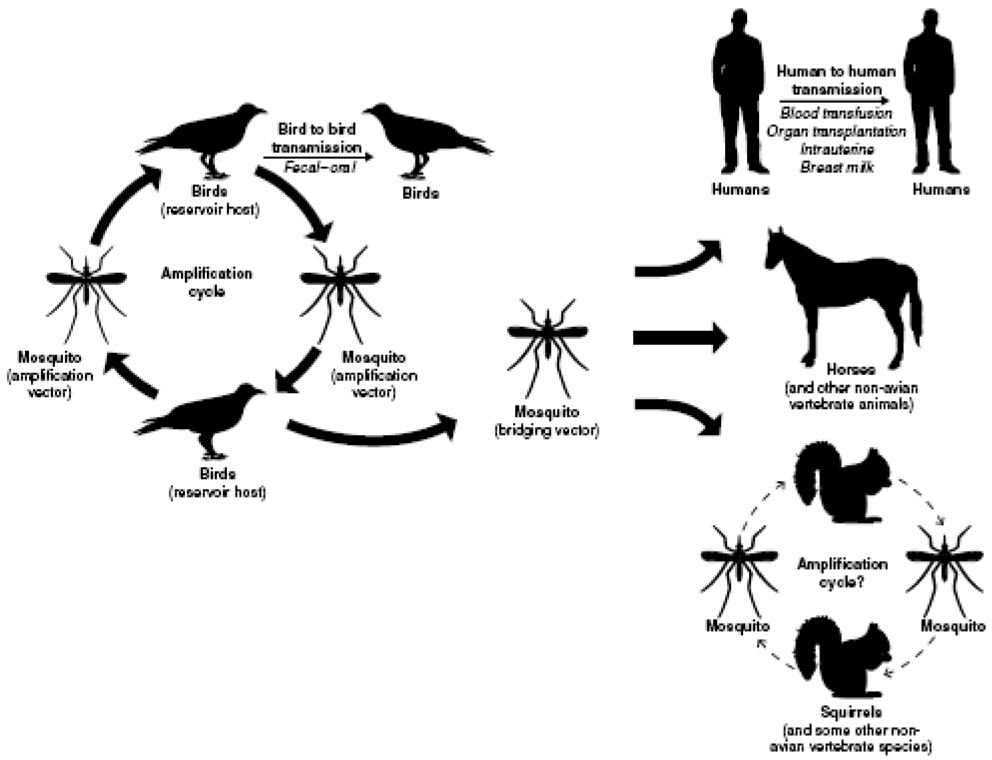
- Dr. Anette Baumer,
  Swiss Institute of Virology and Immunoprophylaxis (IVI);
  SDC Working Group Zoonotic Diseases
- Prof. Dr. Paul Gibbs
  Professor of Virology; College of Veterinary Medicine; University of Florida
- Dr. Arthur Marx
  SDC Expert Group Human Medicine
- Dr. Sonia Menéndez González; *SDC Working Group Zoonotic Diseases*
  Swiss Federal Veterinary Office (SFVO)

- Dr. Ulrich Sperling
  Head of Mission
  SAFOSO; SDC Working Group Zoonotic Diseases

4 Technical Background

4.1 *Transmission cycles of West Nile virus and other arboviruses causing encephalitides in the Americas*

West Nile virus is one of several arthropod-borne viruses (arboviruses) capable of causing neurological disease in humans, domestic animals (predominantly horses), and wildlife in the Americas. The most important of these viruses are West Nile Virus (WNV), Eastern Equine Encephalitis Virus (EEEV), Western Equine Encephalitis Virus (WEEV), Venezuelan Equine Encephalitis Virus (VEEV), and St.Louis Encephalitis Virus (SLEV). They are transmitted by mosquitoes. West Nile virus and SLEV are classified as Flaviviruses and EEEV, WEEV, and VEEV as Alphaviruses within the Togavirus family.
West Nile Virus is maintained in a bird-mosquito transmission cycle. Humans, equines and other non-avian vertebrates are usually end-hosts; they can get infected through mosquito bites but do not develop a significant viremia to allow further transmission. Nevertheless, there is evidence that certain non-avian vertebrates might act as natural reservoirs. Migratory birds are considered to spread the virus over long distances. Human to human transmission through manipulation of infected material, blood transfusion, organ transplantation, breast milk, and intrauterine infection has been reported in the literature.



(WNV transmission cycle. Blitvich, B. (2008))

Culex species mosquitoes are the major amplification vectors, although WNV has been isolated from many other genera. Feeding patterns of mosquitoes play an important role in the

transmission of WNV between animal species. Thus, ornithophilic species are mainly involved in the endemic cycle.
The transmission cycles of EEEV, WEEV, VEEV and SLEV are analogous to that of WNV, with differences regarding vector species. The natural reservoirs of VEEV are rodents instead of birds, and equines can serve as amplifying hosts for the epizootic strains. EEEV and VEEV usually produce more severe disease. EEEV and WEEV have been reported to cause disease in poultry. Further information can be found at OIE (www.oie.int) and scientific literature.

Yellow fever virus and Dengue virus (both Flaviviruses) are two other important arboviruses that cause clinical disease in humans in the Americas. Neither is of veterinary importance. Dengue is maintained in a transmission cycle involving humans and mosquitoes, generally in a peri-domestic setting. Yellow fever epidemics are also maintained by a mosquito –human transmission cycle. In contrast with Dengue, there is a sylvatic reservoir of Yellow fever virus in South America involving monkeys.

4.2 History of West Nile viral infections and other viral encephalitides in Central America affecting animals and people

Whereas the viruses of EEE, WEE, VEE, and SLE are considered indigenous to the New World, WN, Yellow fever, and Dengue viruses are considered introduced viruses from the Old World. Yellow fever was introduced by the early European colonists. The introduction of Dengue is less certain. What is certain is that WNV, by comparison with Yellow fever and Dengue viruses, is a very recent introduction.

In late summer of 1999, viral encephalitis killed several people in New York. The virus was also recognized to be causing death in indigenous species of birds. Initially the causal virus was diagnosed as St Louis encephalitis virus (SLEV), but after a veterinarian working in the Bronx zoo had pointed out that SLEV was not known to cause mortality in birds, its identity was finally established as West Nile virus (WNV). At that time, it was difficult to imagine that four years later the virus would have spread from coast-to-coast in the USA and in its first decade in the Western Hemisphere. Today, WNV infections represent the most common vector –borne infections in North America and will significantly impact public health for the foreseeable future (Peterson, L.R. 2009. Ten Years Later, National West Nile Virus Conference, Savannah, Georgia. http://www.cdc.gov/ncidod/dvbid/westnile/conf/index.htm). West Nile virus symbolizes the increasing geographical spread of arboviruses brought on by globalization, societal and environmental factors.
Since 1999, there have been approximately 29’000 clinical cases of WNV infection in humans in the USA alone, of which nearly 12’000 were associated with neurological disease. 1’130 have died. These statistics, however, do not portray the extent of infection. The subclinical to clinical ratio is estimated to be 1:140 from which it is calculated that over 1.5 million persons have been infected with WNV in the decade since its discovery in North America. In the USA, these subclinical cases led to 32 blood transfusion-related cases before all transfusions were screened for the virus. There have been eight cases related to organ transplants.

West Nile virus has also caused extensive mortality in horses and wild birds in North America. The epidemic in birds has principally affected corvids (crows, jays and magpies) and thousands, possibly millions, of birds have died. While the introduction of effective vaccines for use in horses in the fall of 2001 has markedly reduced the impact of the disease on the horse population of North America, over 25,000 horses have died.

4.3 The Spread of West Nile Virus to Central America and the Caribbean Region since 1999

The data presented in the previous section on the extent of West Nile disease in the USA illustrate the importance of this virus as a pathogen of both animals and people. While there is no published evidence that WNV infects either people or animals in Costa Rica, the virus has been recognized affecting animals and people in several countries to the North (USA, Canada, Mexico, Belize and Guatemala), to the East (Cuba, Cayman Islands, Puerto Rico, Guadeloupe, and Trinidad and Tobago) and to the South (Colombia and Argentina). Based on the history of WNV in North America, it is seen as inevitable that WN virus will soon arrive in Costa Rica. Indeed, the virus may already be present, but no clinical disease has been detected as yet. Competent vectors such as *C. tarsalis, C. quinquefasciatus, C. nigripalpus,* and *C. pipiens* are present in Costa Rica and the ecological conditions of the country allow for mosquito activity over the whole year. However, while the virus has spread to several Caribbean islands and countries in Central America lying north of Costa Rica, the impact of the disease in these countries has been minimal. There is no convincing explanation why. It is thought that previous infections of both hosts and vectors with other flaviviruses might explain this phenomenon, but further research on this hypothesis is needed (see presentations at the 2009 West Nile conference for more detail http://www.cdc.gov/ncidod/dvbid/westnile/conf/index.htm).

In light of the potential impact of WN virus on the equine, human, and wildlife populations of Costa Rica, it is prudent for Cost Rica to prepare for its arrival. However, other viral diseases need to be differentiated from West Nile infections.

Venezuelan equine encephalitis, EEE, WEE and rabies viruses are associated with neurological disease in humans and horses in the Americas. St Louis encephalitis virus causes disease in humans, but not in animals. Rabies is endemic in wildlife in Costa Rica. Venezuelan equine encephalitis, EEE, and WEE viruses are distributed across the Americas and involve different vectors and reservoir hosts dependent upon the geographical location. VEE is one of the most important veterinary pathogens in the New World. An epidemic in 1969-1971 affected several countries to the north of Costa Rica and spread into the USA. In the 1990’s outbreaks occurred in Venezuela, Colombia, and Mexico. Eastern and Western equine encephalitis are mostly a problem in North America. While all three viruses are believed to be present in Costa Rica, none has been associated with clinical disease in any species. Recent reviews on these diseases are available (Gibbs, EPJ and Long MT, Chapter 20 Alphaviruses in Equine Infectious Diseases pages 191-197).

As mentioned earlier, the flavivirus family also includes Yellow fever virus and Dengue virus; two viruses that primarily affect humans without domestic animal involvement. Historically, Yellow fever affected the human population in Costa Rica, but vector control and vaccination has eradicated the disease. Dengue is an important disease in Costa Rica and the epidemiology of the disease is now more complex with the introduction of a second serotype. West Nile causes encephalitis in only a minority of infected patients and animals. Many of those infected develop fevers. The diagnosis of West Nile infection needs to be considered in patients presenting with fevers.

4.4 Current reports of neurological disease in horses in Costa Rica and use of vaccines

There are many causes of neurological disease in horses in the Western Hemisphere. In addition to the viruses mentioned above (WN, EEE , WEE , VEE and rabies viruses), equine herpes virus 1, can also be expected to occur in horses in Costa Rica. Interviews with veterinarians in equine practice in Costa Rica indicated that while cases of rabies occur in horses throughout Costa Rica, none of the arboviral encephalitides has been confirmed as causing clinical disease in horses. Hepatic encephalopathy (caused by plant toxins) occurs in horses in Costa Rica and could be clinically confused with the arboviral encephalitides. Although vaccines for EEE, WEE, and VEE are available, most horses in Costa Rica are not vaccinated against these diseases. Vaccines against WNV are available for equines in North America, but have not been licensed for use in Costa Rica.

4.5 West Nile Fever (WNF) and International Health Regulations

West Nile Fever is a key disease addressed in the International Health Regulations (IHR 2005, www.who.int/csr/ihr/IHR_2005_en.pdf):
"An event involving the following diseases shall always lead to utilization of the algorithm, because they have demonstrated the ability to cause serious public health impact and to spread rapidly internationally :
- Cholera
- Pneumonic plague
- Yellow fever
- Viral haemorrhagic fevers (Ebola, Lassa, Marburg)
- West Nile fever
- Other diseases that are of special national or regional concern, e.g. dengue fever, Rift Valley fever, and meningococcal disease.

5 Diagnostic capacity

5.1 Veterinary diagnostic capacity

There are two official veterinary laboratories at the central level and three at the regional level. The National Laboratory for Veterinary Services (Laboratorio Nacional de servicios Veterinarios, LANASEVE) belongs to the National Service of Animal Health (SENASA) and the laboratory at the veterinary school of the National University (UNA) are located in San José. There is one regional laboratory in Liberia (Guanacaste region), one in San Isidro and another in Ciudad Quesada. The three regional laboratories are strategically distributed so that the complete country is covered. In addition, there are four private diagnostic laboratories with an official status.

SENASA is planning to equip a new BSL-2 laboratory in 2010, but international support is needed to proceed conforming to international biosafety standards. For the time being the following methods are used: ELISA, AGID, HIT, immunofluorescence, immunohistology and PCR (conventional and real time). Sufficient well trained personnel exist but there is a shortage of reagents and they are at a high cost (at the moment one PCR reaction costs about 50 dollars). Currently there are no sequencing facilities at SENASA, all sequencing (avian influenza) is done at the laboratory of the veterinary school. This laboratory is well equipped and the following methods can be performed: ELISA, virus isolation, PCR, and sequencing. The scientific knowledge at the University is broad and they already serve as an informal national reference laboratory. This status as reference laboratory could be formalised within the framework of the West Nile surveillance program possibly even for the human samples. Links to the human health side (INCIENSA) are established through an agreement in a Masters program in epidemiology and human health. The reference status of the university laboratory could be even extended as far as a regional approach (Central America). As for the international collaboration following partners are already involved: OIE reference laboratories in Canada (Brucellosis, BSE, rabies), USA (WNV) and Spain (African Swine Fever/Classical Swine Fever). With specific reference to West Nile diagnostics, two years ago sera from clinically normal horses were reported to have been screened for antibody to WNV. However, all attempts to track down the test results and where the sera were examined proved unsuccessful.

In addition to visiting the laboratories in San Jose, the team visited the regional laboratory in Liberia where basic diagnostic tests for classical swine fever, brucellosis, equine infectious anaemia and coprology are performed. This laboratory is staffed with one technician and one veterinarian. Positive samples are sent by local bus to the central laboratory of SENASA for confirmation. Collaboration with the human regional laboratory exists in Liberia in the field of brucellosis and leptospirosis (five notifications in 2008). SENASA notifies MinSA of positive cases for follow-up on the human side and these follow-up activities are sometimes, but not always, supported by SENASA staff.

Recommendation:
see recommendations under 5.2

5.2 Human clinical diagnostic capacity

A visit to the Instituto Costarricense de Investigación y Enseñanza en Nutrición y Salud (INCIENSA, www.inciensa.sa.cr) virology laboratory revealed the following findings:

The laboratory is headed by Ms. Elisabeth Sáenz, microbiologist. INCIENSA belongs to the Ministry of Health (MinSa), but also reports to the Ministry of Social Security (MTSS). While MinSa has the strategic lead, MTSS is responsible for operational oversight of health care services. The meeting was attended by Ms. Elisabeth Sáenz, Ms. Ana Ruíz, and Mr. Hebleen Brenes Porras. Collaboration between animal and human health already exists on leptospirosis, brucellosis and tuberculosis control. Proficiency testing is carried out for measles (external reference lab in Panama), influenza (Bolivia), rubella, dengue (CDC Puerto Rico), and polio (CDC Atlanta). The Instituto Conmemorativo Gorgas de Estudios de la Salud (ICGES) in Panama serves as technical resource centre for yellow fever proficiency testing. The laboratory has a state-of-the art setup with adequate capacity for serologic testing (monoclonal antibodies), normal and real-time PCR, virus culture and isolation, immunofluorescence and microscopy. All specimens and test results are tracked electronically. PCR extraction, amplification and sequencing are carried out in separate rooms, equipped with hood and laminar flow. The specimens have to be carried by hand through the corridor, though. The setup is compatible with BSL II-II+.

INCIENSA is connected with various lab networks, including CDC Atlanta and San Juan/Puerto Rico, Centro de Enfermedades Tropicales Bolivia, IPK, Instituto Nacional de Salud, Bogotá, Colombia, Gorgas, PAHO.

There is no routine testing for WNV, but a strong desire to establish this capacity as soon as possible. In 2008, 14 clinical specimens from patients with manifest encephalitis were submitted to INCIENSA; using commercial assays, none of them tested positive for WNV.

A visit to the regional hospital in Liberia showed that clinical encephalitic disease mostly is associated clinically and serologically with dengue (haemorrhagic) fever. While clinical staff are very experienced in diagnosing dengue fever and malaria, experience and awareness for West Nile fever is missing. Previous dengue infection frequently is associated with severe neurologic or haemorrhagic dengue fever. WNV might go undetected also due to cross-reactivity between dengue- and WNV antibodies, leading to false negative results.
A cross-check between medical records at regional level hospital and INCIENSA database showed that results of serologic and CSF specimens sent to INCIENSA, from two girls aged 16 and 13 years with fatal encephalitis in 2007 and 2008, respectively, could not be found at central level laboratory.
During 2008, 70 cases and during January-February 2009, 5 cases of dengue fever were detected. Surveillance indicators are not formally standardised and used nationwide.
While human infections with neurotropic arboviruses are usually clinically inapparent, most clinically apparent infections are associated with fever, with or without neurologic manifestations, which can range from mild aseptic meningitis to fulminant and fatal encephalitis. Signs and symptoms may include fever, headache, stiff neck, confusion or other mental status changes, nausea, vomiting, meningismus, cranial nerve abnormalities, paresis or paralysis, sensory deficits, altered reflexes, abnormal movements, convulsions, and coma of varying severity. Arboviral meningitis or encephalitis cannot reliably be clinically distinguished from other central nervous system infections.

Recommendations regarding diagnostic capacity (5.1 and 5.2):

- Establish diagnostic capacity for WNV, within one dedicated national reference laboratory, by providing reagents, primers, training, and proficiency testing, within an epidemiologic enhanced passive surveillance framework.
- Seek international support to ensure adequate levels of biosafety in new and existing laboratory infrastructure.
- International contacts should be strengthened and confirmation for positive samples originating from West Nile surveillance program should be intended.
- Provide epidemiological feedback to health care providers.
- Ensure adequate feedback to clinicians submitting samples.

Summary of diagnostic capacities

Disease	**Equidae: Prevalence/ Occurrence (%, or number of equine cases, year of occurrence)**	**Available diagnostic tests for horses in Costa Rica**	**Humans: Prevalence/ Occurrence (%, or number of human cases, year of occurrence)**	**Available diagnostic tests for humans in Costa Rica**
West Nile Virus Encephalitis	Information not available	Currently no diagnostic test available	undetermined	Not yet available for routine testing (limited commercial assays)
Eastern Equine Encephalitis	Information not available	Antibody Capture ELISA for IgM and IgG (specification through Virus Neutralization can only be done abroad)	undetermined	Not available
Western Equine Encephalitis	Information not available	Antibody Capture ELISA for IgM and IgG (specification through Virus Neutralization can only be done abroad)	undetermined	Not available
Venezuelan Equine Encephalitis	Information not available 2006: on the visit of a Dr. Sudhir Sahu from NVSL-APHIS some equine sera were submitted for analysis of Venezuelan Equine Encephalitis. A few animals were found positive to IgM, but not to IgG with an Antibody Captive ELISA. There was no follow-up to these samples. 1997: Outbreak (number of cases?)	Antibody Capture ELISA for IgM and IgG (Specific identification through virus neutralization can only be done abroad)	undetermined	Not available
St. Louis Encephalitis			undetermined	Not available
Dengue (Hemorrhagic) Fever			2008: 70 cases, Jan-Feb 2009: 5 cases	Serology, PCR, virus isolation, external proficiency testing

6 Surveillance of arboviruses causing encephalitides

6.1 Surveillance approach

In order to detect the presence of WNV in the country and due to the complexity of its natural history and the generally low frequency of clinical manifestations observed in Central and South America, the surveillance approach adopted should be comprehensive, covering different species, and continuous over time. Moreover, to increase the sensitivity of detection that could be obtained through merely passive data collection, risk-based active surveillance should be implemented. Communication activities directed to physicians, veterinarians, farmers, biologists and other stakeholders including the public should be regarded as a key element to ensure their involvement and the efficacy of surveillance. Strategies for timely response to surveillance data should be developed to prevent disease in humans and animals, and should include vector control and public education. To achieve this in a cost-efficient way, the existing infrastructures, networks and synergisms among institutions should be used and further developed at national, regional and local level.

Passive surveillance relies on reports of suspected cases of disease to the competent authorities. Although it covers the whole country, its validity depends on the level of disease awareness and the willingness of reporting. The term “enhanced” implies a regular communication effort to raise and maintain awareness among human and animal health care personnel, animal owners, general public and other stakeholders.
Active surveillance involves regular and specific data collection by the competent authorities. Because of the apparent absence of clinical disease, this approach is needed to increase the sensitivity of passive surveillance. Besides this, active surveillance enables to set logistic and operational networks and to get field and laboratory experience, and therefore, contributes to disease preparedness.

There are several approaches to developing a surveillance system to detect WNV activity in a country. In the early stages of the epidemic in North America, detection of dead birds (principally dead corvids) and neurological disease in horses provided evidence of viral activity in an area and generally preceded the onset of disease in humans. With the introduction of equine vaccination, the value of horses as a sentinel species in North America has diminished.

Recommendation:

- West Nile fever in humans should become a notifiable disease, complemented by syndromic surveillance for encephalitis. WNV infection already is notifiable in animals.
- It is recommended to establish both passive and active surveillance strategies in human and animal populations.

6.2 Human Health Surveillance

See also 5.2 Human clinical diagnostic capacity

A meeting with Dra. Maria Ethel Trejos Solarzana, Head of MinSa Surveillance Unit, Dr. José Luis Garces Fernandes, Dr. Henry Wasserman, and Dr. Carlos Alfaro Rojas, later on joined by Dr. Roberto Del Aguila, PAHO, brought the following findings: Carlos Alfaro Rojas, DVM, is the focal point for zoonotic diseases. Main goals are to streamline surveillance in Costa Rica with the PAHO initiative for Central America and the IHR 2005, as well as to establish a around-the-clock inter-institutional response coordination committee. Dr. Teresita Solano, who had initiated the MinSa Entomological Support Group, recently left the Unit. In 2008, 8'812 dengue fever cases were reported, 90% of them in Limón and Martina districts, on the Caribbean coast. Three cases of *Plasmodium falciparum* malaria were imported from Colombia, 903 cases of *P. vivax* reported in the country.
At Liberia hospital and Regional Health Department (Direccion de Salud), the team met with the surveillance focal points. For selected diseases, the health department receives daily reports, including zero reporting. Dengue cases trigger proactive surveillance, including epidemiological investigation and vector control (spraying) within a radius of 400 m around households where cases have been confirmed.

Blood transfusion service
Meeting with Dr. Sebastian Molina: although recognized as potential ways of transmission, blood donations, organ- and tissue transplants currently are not screened for WNV, since it is not considered a high-prevalence disease in Costa Rica. There are no resources to establish diagnostic test capacity or to carry out seroprevalence surveys. Around 27'000 blood donations are processed annually, of which ~5% are re-tested externally for hemovigilance and quality assurance. Hemovigilance is epidemiological surveillance of undesirable effects associated with the appearance or resurgence of problems related to blood products and their substitutes.

Recommendation:
As soon as WNV has been detected in Costa Rica and pending available diagnostic capacity,
- Determine the seroprevalence of WNV infection in Costa Rica through representative, population-based sentinel sero-surveys.
- Test blood product and organ/tissue donations for WNV, in coordination with the national reference lab.

Enhanced passive surveillance
In the absence of known WNV activity in an area, enhanced passive surveillance for hospitalized cases of encephalitis (and milder clinical syndromes as resources allow), and for patients who have IgM antibodies to either WNV or SLEV in tests conducted in diagnostic or reference laboratories, should be employed. Passive surveillance includes reports enhanced by general alerts to key health care personnel such as primary care providers, infectious disease physicians, neurologists, hospital infection control personnel, and diagnostic laboratories. A high clinical suspicion for arboviral encephalitis should be encouraged among health care providers. When the diagnosis is in doubt, appropriate clinical specimens should be submitted to laboratories capable of performing reliable serologic testing for antibodies to arboviruses. Testing of CSF and paired acute- and convalescent-phase serum samples should be strongly encouraged to maximize the accuracy of serologic results.
In a next step and resources permitting, **sentinel surveillance** should be established.
Research programmes should be promoted, also for ensuring funding resources.

6.3 Veterinary surveillance

Besides the central headquarters at San José, SENASA has a network covering the country of official veterinarians (132; status July 2008), technicians (108) and private veterinarians.. These individuals are responsible, among other activities, for surveillance in the field, regulatory control of specified diseases, and farm and animal population censuses. SENSA also plays an important role in the direct dissemination of information to animal owners. Operationally, the country is divided into 2243 'cuadrículas', i.e. 5 km^2 squares that are grouped into eight regions with SENSA personnel assigned to specific cuadriculas.. As part of the educational mission, SENASA conducts simulation exercises.

An electronic information system for surveillance activities (SIVE: sistema de información para la vigilancia epidemiológica) is being implemented and should allow in the future the on-line data transfer to a central database and data-sharing. A national register currently contains 90% of the bovine operations, which are identified by a unique number. Individual animals are not identified yet. For equines, a register of operations and a population census are expected in the next two years. Equines in Costa Rica are mainly used for work (cattle farming), transportation and pleasure (e.g., festivals).

6.3.1 Enhanced passive surveillance for equines (clinical cases of encephalopathy)

Animal encephalitis due to WNV, EEEV, WEEV, VEEV and JEV are subject to mandatory notification in Costa Rica (Decree published in the Gaceta n° 156 of August 13th. 2008), but are not subject to surveillance . Criteria to develop a surveillance programme include the zoonotic potential of disease, its impact in production and commerce, its presence in the country (endemic/exotic), the susceptible population, and the diagnostic capacity. Surveillance programmes exist against diseases with high morbidity and mortality in poultry (avian influenza, Newcastle disease), diseases with high morbidity and mortality in pigs (classical swine fever), vesicular diseases (foot- and-mouth disease, vesicular stomatitis), neurological diseases in cattle (rabies, bovine spongiform encephalopathy), and myasis. Diagnostic testing for such diseases is free for animal owners. Surveillance programmes are anchored in the legislation through directives of SENASA or decrees of MAG.

A serosurvey of horses for antibody to WNV was apparently conducted in 2007 in Guanacaste region. This was reported to have been organized through the University. Attempts to trace the results were unsuccessful. Sporadic cases of encephalitis in horses have occurred in this region, but were not tested. Costa Rica has never reported cases of WNV to the OIE, and there is no information available on EEEV, WEEV and VEEV.

Recommendation:

- An enhanced passive surveillance based on the observation of neurological diseases in equines is recommended

<u>Goal of equine passive surveillance</u>
Detection of clinical cases of encephalitis in equines. The information can be further used to identify risk areas, assess the threat for human health and the need of interventions.

Concept

A syndromic surveillance of neurologic disease in equines, as it already exists for cattle, should be developed. The existing network of official veterinarians and technicians, their proximity to the animal owners and the realization of the equine census in next future should be used to raise and maintain disease awareness among owners.

Description

Clinical signs compatible with viral encephalitis in equines should be reported by animal owners or private practitioners to the field veterinary officers who, after examination of the case and if appropriate, should submit clinical specimens for laboratory diagnostic accompanied by a case-report form in which the vaccination status should be included. If a case is confirmed vector control measures should be immediately implemented in coordination with human health authorities.

Probable case definition - Clinical signs should include one or more of the following: depression, fasciculations, ataxia (stumbling, staggering, wobbly gait, or incoordination), weakness, inability to stand, death, fever, change in mentation, and cranial nerve abnormalities (primarily, weakness of the tongue). Horses are commonly hyperaesthetic for one to several days, and sometimes present with rapid onset of head pressing, coma, aimless wandering and blindness.

Specimens:

- In living horses, diagnostic confirmation generally relies on evidence of recent seroconversion (blood, or cerebrospinal fluid (CSF)), a 4-fold increase in plaque reduction neutralization test (PRNT) antibody titers between paired serum samples taken 2 weeks apart. Most horses with WNV encephalitis test positive in the IgM capture ELISA at the time that clinical signs are first observed. WNV neutralizing antibodies are detectable in equine serum by 2 weeks post-infection and can persist for more than 1 year.

Specimen for PCR include following tissues: brain, heart or liver, as well as CSF and serum can be used.

Differential diagnoses

Arboviral encephalitis, rabies, encephalitis by *Sarcocystis neurona*, equine herpesvirus-1, Borna disease, plant intoxications.

Confirmed case definition

A case definition needs to be developed in relation to the diagnostics available.

Measures in case of confirmed case

An epidemiological investigation should be started after confirmation of the case. This investigation involves collaboration of veterinary and health authorities as well as entomologists, and should include:

- Creation of a buffer area around the farm affected (extension given by the flight patterns of vectors, approx. 3 km radius)
- Visits to equine operations present in the buffer area for detection of recent cases and seroconversion in equines.
- Information of the population in the buffer area and neighbouring communities about the clinical manifestations of disease (humans, equines and birds), personal and animal protection measures (owners should be awarded of equines vaccines), sanitation activities, and contact authorities for reporting new suspected cases.

- Active mosquito surveillance in the buffer area (collection and identification of adults and eventually larvae, testing of virus in mosquitoes, identification and sanitation of breeding sites).

Other than for animal welfare reasons, affected horses need not be culled as they are dead end hosts,. Suggested protective measures for horses can be downloaded from:
http://www.aphis.usda.gov/vs/nahss/equine/wnv/ada_wnv_2007.pdf

Comments

Passive surveillance covers the whole equine population and may be more useful in areas where equines are abundant. In the USA, equine WNV disease cases have been reported to precede disease in humans. Equine vaccines against arboviruses are seldom employed in Costa Rica (no vaccine registered against WNV). Nevertheless, the sensitivity of passive surveillance may be limited by the lack of clinical manifestations and by low disease awareness.

6.3.2 Enhanced passive surveillance of wild bird mortality [2]

Costa Rica contains 5% of the global biodiversity, ranking third worldwide. Over 26% of the national territory is under protection (national parks and reserves). State protected areas are located mainly in the mountains and along the coasts, and are managed by MINAE (Ministry of Environment and Energy) and INBio (Instituto Nacional de Biodiversidad). Private protected areas are distributed over the whole country. State protected areas received one million visitors in 2008. Their receipts are not fully invested in the areas, but encased in national funds and distributed among public institutions. More than 500 rangers and other personnel work in the State areas. Nature attracts tourism, which is an important economic sector for Costa Rica. Loss of biodiversity or cases of encephalitis in humans would negatively affect tourism, travel and trade.

In Costa Rica, over 860 bird species have been described, 600 of them residents. ‘Important bird areas’ (IBAs) have been identified by BirdLife International as sites of international importance for the conservation of birds (especially migratory birds). Costa Rica has two main migratory flyways, the Pacific and the Atlantic, the latter being frequented by many Passeriformes species. North to South migration occurs between September and November, whereas South to North occurs between March and April.

Goal of wild bird passive surveillance: use of bird mortality associated with arbovirus infection to detect arbovirus activity in a location.

Concept – Timely reporting of dead bird sightings and testing of selected specimens for arboviruses should be carried out in protected and non-protected areas. Existing infrastructures should be used for educational and operational purposes as far as possible.

Description – Protected areas are part of migratory flyways and therefore, represent areas of potential introduction of arboviruses carried by birds. By means of targeted education, disease awareness should be raised among the personnel working in these areas, and methods for collection and shipping of samples should be instructed. Logistic and operational activities should be coordinated among the MAG-SENASA and the MINAE (education, materials, etc.). In non-protected areas, public should be educated to report dead bird sightings to the

[2] Wild bird surveillance does not apply for VEEV.

competent authorities. The network of field veterinary officers could be used for sample collection and shipping. Reporting of clustered instead of single deaths should be encouraged. Information collected should include date, location, species and number of birds affected. Collection and submission of samples should depend on the condition of the carcasses, the available resources available and the existence of previous reports in the area. In case of detection of circulating arboviruses, control measures should be implemented in coordination with human health authorities.

Specimens
Most species of birds can become infected with WNV. The clinical outcome of infection is variable. Bird tissues generally contain higher concentration of virus than equine tissues. Brain, heart, kidney, spleen, liver, intestine and lung tissues can be used for PCR.

Case definition
A case definition needs to be developed depending on the diagnostics available.

Measures in case of confirmed case
- Enhance disease awareness in the population.
- Surveillance should be intensified if bird mortality due to arboviruses continues.

Comments
Passive wild bird mortality surveillance has a large coverage, including areas where equines are not present, and involves public participation. Avian mortality has been used as a sensitive detection system for WNV activity and as indicator of risk for human health in the USA. However, its efficacy in Central America might be different depending on the species composition and their susceptibility to disease. Moreover, mortality may be due to other causes. The sensitivity of passive surveillance may also be limited by low disease awareness or lack of motivation of personnel in protected areas. Collection, handling and processing of samples is time consuming, and the surveillance system may be overwhelmed by high public response. Detection of arboviruses likely signifies local transmission, but the site of death may be distant from the site of infection.

6.3.3 Risk-based sentinel surveillance in equines and vectors

Sentinel networks keep watch for, or are observed for disease. They are often built from volunteers and are therefore high motivated. Once sentinel units have been established and informed, they supply information continuously and have high disease awareness, thus, there is an increased chance to detect rare events. Sentinel units may be selected at random, per convenience or risk-based. The latter increases sensitivity of detection and thus, allows a more efficient allocation of resources. The establishment of sentinel surveillance requires appropriate choice of sentinel locations, sentinel animals, frequency of sampling, and diagnostic methods.

In Costa Rica, no vaccine against WNV is registered and vaccines against EEEV, WEEV and VEEV are seldom used in equines. Thus, equines could be used as effective sentinels to detect disease or seroconversion.

Goal of veterinary risk-based sentinel surveillance
Detection of arbovirus activity in a location by using clinical disease and/or seroconversion in horses

Concept

A sentinel network of equines located in areas with higher probability of arbovirus circulation should be established. Sentinel sites could be used to further investigate the presence of circulating arboviruses in other species and to gather data on the ecology of disease. Collaboration between veterinary authorities (network of field veterinary officers, contact to animal owners) and entomologists (vector ecology, field expertise) should be enhanced.

Description

A) Sentinel equines

A risk-based approach increases the probability of positive findings by focusing on subpopulations at higher risk of disease. In the case of the arboviral diseases of interest, these subpopulations can be selected by identifying vector habitats such as swamps, marshy forests, temporary ponds, and rivers (altitude <1500 m). Identification of risk areas requires entomological expertise. The use of geographical information systems (GIS) may be of help. The equine farms within those areas are potential sentinel units. The realization of an equine census in the near future should help to identify them. Once identified, selection of sentinel farms should be based on criteria such as number of (seronegative) equines available, history of vaccination, proximity to areas with migratory birds, proximity to human populations (to account for the risk for human health), and commitment from the farm owner (owner informed consent sheet recommended). Feed-back or other incentives increases the owner's motivation. The number of sentinel farms to include depends on available resources. After 2-3 years, new sentinel farms should be selected in light of new epidemiological data and to release owners.

The initial characterization of sentinel farms should include relevant ecological information (climate, topography, vegetation, presence of vector breeding sites, etc.). Non-vaccinated equines older than 4-6 months should be initially tested for detection of antibodies against arboviruses. It is suggested to select all (healthy) seronegative animals as sentinels from stables with <30 seronegatives (WinEpiscope, sample size for detection of disease=29, N=30, number of infected=1). Based on epidemiological considerations, competent vectors do not have a feeding preference for equines, and thus, the number of seroconversions observed at a point of time is likely to be low. From stables with >30 seronegatives, at least 30 should be selected (randomly or considering owner's preference); more animals could be added to increase the probability of detection. Sentinel animals should be then unequivocal identified, examined, and relevant data on it should be collected and, if needed, updated at each visit (age, breed, sex, use, origin, type of stable, health events, animal movements to other areas, etc.).

Blood samples from sentinel animals should be taken at regular intervals. The sampling frequency (fortnightly, monthly, or other) should take the epidemiological considerations (WNV-specific antibodies are detectable 7 – 10 days post infection; timing with potential of detection in vectors) and availability of resources into account. Sampling should be carried out over the whole year, and results for each animal should be recorded.

Specimens

Serum from the sentinel horses can be pooled to save resources. But the pooling should be done in the laboratory in order that a positive pool can be re-tested separately.

B) Vector surveillance in sentinel farms

It is highly recommended to establish parallel vector surveillance in the sentinel farms. Adult mosquitoes could be collected at the same time of equine sampling to identify primary vector species and their relative density in the area. If coupled with virus detection, it could provide a quantifiable index of arbovirus activity. The infection rate has been associated with subsequent disease outbreaks in the USA. Nevertheless, if resources are limited, it is recommended to restrict virus detection to cases of seroconversion or few sentinel sites. Parallel vector surveillance requires close collaboration of veterinarians, entomologists, and even animal owners, who could be instructed to place the traps.

Measures in case of detection of arbovirus activity

If seroconversion in equines or arboviruses in vectors are detected, an epidemiological investigation should be initiated (see enhanced passive surveillance in horses).

Comments

Risk-based sentinel surveillance is cost-efficient and flexible; it can be expanded and contracted as appropriate (more or less farms, more or less intensive vector surveillance). Further sentinel sites could be set in non-risk areas to increase coverage.

6.3.4 Active veterinary surveillance integrated in other activities

Further surveillance activities should be integrated in other research programmes to increase sensitivity at low costs. For instance, testing for arboviruses could be integrated in projects already planned by University, non-governmental organizations and other institutions that involve capture and testing of wild animals (birds for avian influenza, rodents for *Leishmania spp*.).

6.3.5 Comments on other options for active veterinary surveillance

Despite the lack of farm or animal census data for equines in Costa Rica, a sero-survey in horses based on a representative sampling of ‘cuadriculas’ could be carried out. This approach could provide data on seroprevalence, but due to the lack of clinical signs and the short viremia, the probability of detecting virus circulation would be low. Moreover, the results would represent a “point in time”

Surveillance based on sentinel chicken flocks has been used in the USA to detect and monitor arboviral diseases. However, sentinel flocks are subject to vandalism and predators, and training is required for proper maintenance and sampling.

Free-ranging bird surveillance focuses reservoir host species, but it is logistically difficult. Optimal bird species should be selected, live-trapping and handling requires special training and permission, serial bleeding is usually not feasible, interpretation of serological results is difficult, and it is not possible to know where an infection was acquired.

7 Vaccination strategy

Discussions with veterinarians and horse managers indicated that cases of equine encephalitis were rare events. Vaccines are available for rabies, VEEV, EEEV, and WEEV but they are not used extensively. This situation is similar to that seen in other Caribbean and Central American countries. Until such time that WNV is recognized as a cause of clinical disease in horses, there is no justification for recommending that horses be routinely vaccinated. The only exception to this policy would be vaccination of the occasional horse that is exported to a country, such as the USA, where WNV is endemic and clinical cases of WNV encephalitis are known to occur.

Since horses in Costa Rica are not currently vaccinated against WNV, this provides a valuable opportunity to integrate horses into a surveillance system to detect WNV virus activity as mentioned above.

Recommendation

- Establish mechanisms for the rapid purchase of WN vaccine for use in horses should emergency vaccination be necessary in the event of an outbreak of WN disease in horses.

8 Vector surveillance and control

In Costa Rica, entomological surveillance and vector control activities related to dengue have been coordinated by the MINSA and operated by the Caja de la Seguridad Social. Competences are currently being transferred to the Caja. Many activities are based on local programmes in the communities that involve variety of stakeholders. Activities include regular visits to households in risk areas for identification of mosquito breeding sites and information campaigns. If cases of dengue are detected, epidemiological investigations and eventually fumigation are carried out. The intensity and timeliness of surveillance and intervention measures are dependent upon availability of human and financial resources.

Entomological expertise exists at INCIENSA (Dr. Nidia Calvo), UNA (Universidad Nacional; Dr. Marco Herrera) and INBio (Institute of Biodiversity). INCIENSA and UNA have focused medical entomology, especially related to dengue and malaria. Master and a Technician Degrees in Medical Entomology are expected to start in 2010; they will cover epidemiological aspects of vector-borne diseases as well as training in field work. In addition, UNA intends to develop a research project for mapping mosquito species in Costa Rica in 2010. Collaboration between MINSA, INCIENSA, SENASA and UNA exists for diseases such as malaria, leishmaniosis and vesicular stomatitis. According to M. Herrera, an extensive vector surveillance and control programme would need initial support of national and international donors and could be sustainable if it is then maintained by local stakeholders.

Vector surveillance provides early evidence of local transmission, indicates potential risk to humans and animals and allows evaluation of control methods. However, it is labor-intensive and expensive. Comprehensive vector surveillance includes larval and adult sampling, a mapping/record keeping component, a virus-testing component, and a data analysis component. Technical details about this type of surveillance, as well as suggestions for control and prevention measures are described in CDC guidelines (http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf).

It is recommended to progressively establish vector surveillance and control programs, with special focus on urban and periurban areas where vectors are likely to be present, complemented with sentinel vector surveillance in rural areas. Collaboration of public health specialists and entomologists, as well as involvement of the community should be fostered to ensure sustainability and efficacy of this type of surveillance.

Vector control and mosquito-based surveillance are inevitably linked. Vector control programmes have been established nationwide for dengue fever and pilot projects for malaria in Limón and Martina districts.

See also Centers for Disease Control and Prevention (CDC) Epidemic/Epizootic West Nile Virus Guidelines for Surveillance, Prevention, and Control (www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-apr-2001.pdf, pp. 15-17, 27 cont'd).

Recommendations:

Vector-control strategy			
Action	**Description**	**Level**	**Timeline**
Information & Education, investigation of cases and contacts	Integration in dengue control	Local units	Immediate
Reinforce vector surveillance	All-year, identification of breeding sites	Local units	Immediate
Coordination	Harmonise different vector-borne disease control programmes	Central level	Immediate
Long-term integrated control	Environment, population	Nationwide	Longer-term

See also CDC Guidelines, 2003, Table 1. Suggested Guidelines for Phased Response to WNV Surveillance Data, pp. 41-2.

9 Communication issues

Ideally, surveillance data on arboviral diseases from all data sources involved (human, equine, avian, vector) should be centrally collected and interpreted based on the input of the multidisciplinary participating parties. Feed-back should be timely provided in order to ensure coordination and timely intervention if needed. Results should be made publicly available (reports, scientific publications).

Risk communication and education through MinSa, SENASA, MAG and other line ministries are not formally coordinated, so a joint risk communication and education strategy should be developed by the competent authorities to raise and maintain disease awareness in human an animal populations. Lack of awareness exists also among human and animal health professionals, who tend to stigmatize the disease as ‘encephalitis’. Different channels should be used to address communication effectively, depending on the target audience: personal interviews (regular visits of human and animal health officers), seminars, fliers, posters, videos, radio senders, internet, etc. In some cases, supplementary information on these diseases could just be ‘added’ to the already operating canals (e.g. fliers given to animal owners, information brochures on dengue).

The information given should include a description of the clinical signs of disease, remarks on its zoonotic potential and the role of vectors in the transmission, and what to do in case of suspicion. Health care personnel should be aware of other clinical manifestations of disease associated with WNV apart from encephalitis which may be confused with dengue or malaria. Depending on the target audience, further advice on personal protection measures, sanitation practices to prevent mosquito breeding, etc. should be provided.

CDC webpage provides examples of material that can be used for information and prevention campaigns: http://www.cdc.gov/ncidod/dvbid/westnile/education.htm

The Caribbean Animal Health Network (CaribVET) is a collaboration of veterinary services, diagnostic laboratories, research institutes and other organizations to improve animal health in the Caribbean. It has created a network on WNV to enhance transfer of knowledge among Caribbean countries. Information could be requested to Dr. Víctor Góngora (Ministry of Agriculture, Belize).

The CDC recommends strategies for social marketing and risk communication for the control of WNV (www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-apr-2001.pdf).

Recommendation

- Develop a joint (MinSa, Senasa, MAG) risk communication and education strategy.
- Establish risk-based communication to health care providers, veterinarians, animal owners and the community.
- Sensitize health care professionals and veterinarians for WNV differential diagnosis in the context of other neurological diseases.

10 Institutional arrangements

10.1 Interface between human and animal health

Collaboration between animal and human health already exists on leptospirosis, brucellosis and tuberculosis control. There are currently no projects to expand this collaboration at the national level.
At regional level, as seen in Guanacaste Region, there are inter-institutional collaboration committees, meeting on regular basis, but also responding to disease reports in animals and humans.
Carlos Alfaro Rojas, DVM, at MinSa Surveillance Unit, is the dedicated focal point for zoonotic diseases.
The Pan American Health Organization (PAHO) unites the function of both WHO and FAO for human and animal health for 45 member countries in the Americas, and in Costa Rica providing support to both MinSa and SENASA. PAHO/WHO Collaborating Centers include BIREME, CLAP, CAREC, INCAP, CEPIS, PANAFTOSA and CFNI. There is no equivalent, however, to the Caribbean Epidemiology Centre (CAREC), for Central America. CAREC is administered on behalf of 21 member countries by PAHO, WHO's Regional Office for the Americas. Under a multilateral agreement, CAREC provides laboratory reference and epidemiology services to 21 member countries.
Apart from the centres in Atlanta/Georgia, Fort Collins/Colorado, and San Juan/Puerto Rico, CDC's Field Epidemiology Training Program (FETP) in Guatemala also serves as a technical resource.

Recommendation:

- Establish a standing inter-institutional committee at the national level to coordinate the response to issues affecting both animal and human health

10.2 Coordination of Clinical, Epidemiological, and Diagnostic Studies on Viral Zoonoses in Costa Rica

As mentioned earlier, West Nile virus symbolizes the increasing geographical spread of arboviruses brought on by globalization, societal and environmental factors. It is also an emerging zoonosis. Accordingly, the team met individuals from many different agencies concerned with animal health (domestic and wildlife) and human health in Costa Rica. The team was impressed with the scientific expertise of those whom they met. The range of activities and the extent of cross disciplinary research *within* an institution was often impressive. Perhaps of even greater relevance, at a time when the "One World One Health" initiative is encouraging greater collaboration across the different health sectors, the team recognized several examples of collaboration *amongst* different agencies. Systematic coordination, however, does not take place.

It is common and quite natural that public authorities or other institutions dealing with zoonotic diseases take a primarily an approach asking 'what are my responsibilities?' and 'what can I do?'. However, the combined actions taken from such an approach will leave gaps and overlaps in effective disease control. Ideally, a coordinating unit – virtual or real – would turn the question around and start with asking 'What needs to be done?', then assign each part of the question to the most appropriate owner. Experience shows that declaring one of the pre-existing units as the coordinating authority is problematic. Instead, it can be built with involvement of <u>all</u> affected units with one of them assuming procedural leadership.

To fulfill this coordination role we propose to found a new center. It may be virtual with regards to infrastructure, meaning it may be hosted by an existing institution. Several options exist as to who should be that host and process owner, but assigning the task to an academic institution would have the advantage of not losing balance upfront between authorities responsible for the human or animal side of zoonotic diseases, respectively.

Such a new center would allow Costa Rica

- to capitalize on its biological diversity,
- strengthen the international recognition that the country has earned through its pioneering work in conservation,
- to coordinate the expertise and achievements of its scientists across many disciplines,
- to recognize the extent of the interdisciplinary cooperation within and between institutions,
- to attract worldwide interest in its leadership role in the implementation of the "One World: One Health" initiative,
- and consequently to attract international funding.

The name of such a new center would need to be carefully chosen, for convenience, until the interested parties in Costa Rica decide upon a name, we propose such it be named *The Costa Rican Center for Emerging Zoonotic Diseases and Conservation Medicine*.

Recommendation:

- Consider creation of a consortium and corresponding center for the coordinated surveillance and control of zoonotic diseases in humans, production animals and wildlife.

11 Annex (A1 – A3)

A1 Differential Diagnosis of WNV Encephalitis, Meningitis, and Other Neuroinvasive Syndromes in Humans

Disease/ Pathogen	Characteristics	Notes
Flaviviridae	Arthropod-borne encephalitis that commonly occurs in the warmer months. Patients usually present with nonspecific constitutional symptoms, e.g., fever, followed by headache, meningeal signs, and photophobia, with or without vomiting, and with deeper structural involvement denoted by mental status change. 5- to 15-day incubation period	Can be distinguished by serologic testing that includes these viral antigens
St. Louis encephalitis	Mosquito borne, most prevalent in midwestern and southern U.S. More severe cases in adults over age 40	Can be distinguished by serologic testing that includes these viral antigens
Powassan fever	Tick borne, less than 40 cases described. Some predilection for children	Can be distinguished by serologic testing that includes these viral antigens
Other mosquito-borne encephalitides	Commonly occur in the warmer months. Patients usually present with nonspecific constitutional symptoms, e.g., fever, followed by headache, meningeal signs, and photophobia, with or without vomiting, and with deeper structural involvement denoted by mental status change	Can be distinguished by serologic testing that includes these viral antigens
Eastern equine encephalitis	Most prevalent in coastal, eastern U.S.; 5- to 10-day incubation period	Can be distinguished by serologic testing that includes these viral antigens
Western equine encephalitis	Most prevalent in central and western U.S. from July to October; 5- to 10-day incubation period	Can be distinguished by serologic testing that includes these viral antigens
La Crosse virus	Endemic in midwestern U.S.; 3- to 7-day incubation period	Can be distinguished by serologic testing that includes these viral antigens
Dengue fever	Hemorrhagic fever predominantly in tropics; 2- to 7-day incubation period	Capillary permeability is prominent feature
Other infectious encephalitides	HSV and related herpes viruses do not have seasonal predisposition. Focal temporal lobe findings on neuroimaging and EEG suggest HSV. Enteroviruses, *Borrelia burgdorferi*, and *Leptospira* may show seasonal patterns, with increased cases during summer and early fall	Focal temporal lobe findings on neuroimaging and periodic lateralizing epileptiform discharges on EEG suggest HSV as opposed to other viral encephalitides

Enteroviral encephalitis	Much less common than enteroviral aseptic meningitis, but 10%-20% of viral encephalitis is estimated to be enteroviral. Immunocompetent persons have a good prognosis	Antibody studies, viral isolation, and nucleic acid amplification testing will distinguish WNV from these other infectious entities
Borrelia burgdorferi infection	Associated with meningitis; other manifestations are generally tick bite history, erythema chronicum migrans, arthritis, radiculopathy, Bell's palsy, and, rarely, meningoencephalitis-multiple sclerosis-like syndrome	Antibody studies, viral isolation, and nucleic acid amplification testing will distinguish WNV from these other infectious entities
Leptospirosis	Leptospira transmission may follow direct contact with urine, blood, or tissue from an infected animal or contaminated water. Usually presents as an influenza-like illness, and about 15% of patients have signs and symptoms of meningitis	Antibody studies, viral isolation, and nucleic acid amplification testing will distinguish WNV from these other infectious entities
Tick paralysis	Ascending flaccid paralysis that begins 5-6 days after wood or dog tick attachment. Ascends symmetrically over several days to result in complete paralysis of the extremities and cranial nerves. Hypo- or areflexia, but sensory and lumbar puncture exam results are typically normal. Diagnosis depends on finding attached tick. Removal of tick results in improvement within a few hours	CSF in WNV acute flaccid paralysis characteristically has pleocytosis and increased protein. In tick paralysis, CSF is generally normal
Stroke	Occurs predominantly in older persons with risk factors of hypertension and vascular disease Anatomically localized findings, often on clinical examination as well as on appropriate neuroimaging (i.e., MRI)	Moderate lymphocytosis in CSF, diffuse EEG findings, and leptomeningeal enhancement on MRI suggest acute encephalitis. In stroke, CT scan will often show hemorrhage early or infarction after 1-2 days. MRI shows infarction and hemorrhage, especially with diffusion-weighted imaging and when fluid-attenuated inversion recovery technique is used
Brain abscess	Uncommon complication of paranasal sinusitis, otitis media, and dental infections. Cerebritis is early stage. Anatomically localized findings, often on clinical examination as well as on appropriate neuroimaging (i.e., MRI)	Anatomically localized and characteristic findings on neuroimaging (i.e., MRI)
Paraspinal epidural abscess	Presents as pain, fever, and rapidly progressive weakness. Pain is almost always midline along spine or radicular. Two thirds of cases result from hematogenous spread from skin, soft tissue, or deep viscera, and one third of cases result from direct extension into subdural space. If lumbar puncture is needed, it should be planned to minimize the risk of inducing meningitis or herniation	MRI localizes abscess. CSF findings are distinct from those of WNV acute flaccid paralysis and consist of pleocytosis with polymorphonuclear cells predominating, increased protein, and reduced glucose

Brain tumor	Usually presents with subacute progression of focal neurologic deficit, seizure, or nonfocal neurologic disorder. Systemic symptoms, such as weight loss, as well as fever, suggest metastatic rather than primary disease	Anatomically localized and characteristic findings on neuroimaging (i.e., MRI). CSF studies may not differentiate from viral encephalitis
Guillain-Barré syndrome	Rapidly evolving areflexic motor paralysis with or without sensory disturbance. Usual pattern is ascending paralysis typically evolving over hours to days. Fever and constitutional symptoms are absent at onset	EMG/NCS show severe asymmetric process involving anterior horn cells in patients with WNV acute flaccid paralysis. EMG/NCS show axonal and/or demyelinating neuropathy

Source: American College of Physicians (ACP), http://pier.acponline.org/physicians/public/d951/diagnosis/d951-s3.html

A2 References and links

Blitvich, B. (2008) Transmission dynamics and changing epidemiology of West Nile virus. Animal Health Research Reviews, 9(1), 71-86

CDC (2003) Epidemic/epizootic West Nile Virus in the United States: guidelines for surveillance, prevention and control. Centre for Disease Control and Prevention. http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf

Comité Intersectorial de Salud (2003) Guía para la vigilancia, prevención y control del virus del Oeste del Nilo. http://www.cenave.gob.mx/von/default.asp?id=30

Dauphin, G. and Zientara, S. (2007) West Nile virus: recent trends in diagnosis and vaccine development. Vaccine, 25, 5563-5576

Gibbs, EPJ and Long MT, Chapter 20 Alphaviruses in Equine Infectious Diseases pages 191-197Komar, N. and Clark, G.G. (2006) West Nile virus activity in Latin America and the Caribbean. Panamerican Journal of Public Health, 19(2), 112-117

Salman, M.D. (2003) Animal disease surveillance and survey systems. Methods and applications. Iowa State Press.

Gongora, V., Trotman, M., Thomas, R., Max, M., Alfonso Zamora, P., Frias Leporeau, M.T., Phanord, S., Quirico, J., Douglas, K., Pegram, R., Martinez, D., Petitclerc, M., Chouin, E., Marchal, C., Chavernac, D., Doyen, D., Vachiéry, N., Molia, S., Hendrikx, P., Lefrançois, T. (2008) The Caribbean Animal Health Network: new tools for harmonization and reinforcement of animal disease surveillance. *Animal Biodiversity and Emerging Diseases: Ann. N. Y. Acad. Sci*. 1149: 12-15

A3 Mission Diary

Thursday, 26.02.09

10.00 – 10.45	Meeting at the Swiss embassy with Ambassador H.R. Hodel and Deputy Ambassador Ms. D. Wälchli
13.00 – 16.00	Kick-off meeting at SENASA headquarter with M. Solano (head department vet. diagnostic laboratory), C. Alfaro Rojas (veterinary at the MoH), A. Sardi (veterinary epidemiologist), B. Leon (veterinarian in reference laboratory), R. Vindas (veterinarian in surveillance program), A. Ruiz (INCIENSA), E. Jiménez, Ms. A. Ruiz and H. Brenes Porras (INCIENSA).

Friday, 27.02.09 (split team)

8.30 – 12.00	Visit of veterinary diagnostics laboratory at SENASA, meeting with B. Leon, M. Solano and M. Urieña (head vet. diagnostic lab) Visit of human virology laboratory at INCIENSA, meeting with Ms. E. Saenz, Ms. A. Ruiz, and Mr. H. Brenes Porras.
14.00 – 15.30	Visit of local blood bank, meeting with S. Molina and Ms. S. Coto

Monday, 2.03.09

8.00 – 9.30	Meeting with M. Baldi (medicina animals silvestres, UNA), L. Sandoval (Unión de Ornithólogos CR) and L. Chaves (Department of Environmental Studies, Emory University)
15.30 – 17.30	Meeting in the regional office of SENASA, Liberia with R. Mora (head of regional vet. lab.), J.L. Hernandez (head of regional office Guanacaste), I. Perez (legal consultant) and E. Ortiz (official veterinarian).

Tuesday, 3.03.09

8:00 – 10.00	Visit at the regional office of the Ministry of Health and the public hospital of Liberia, meeting with M. Calvo (head of cantonal office), Jímenez (head of regional office MoH Guanacaste), F. Barquero (nurse in charge of dengue epidemiology), Ms. I. Ugarte (nurse in charge of dengue surveillance), Ms. I. Pizarro (nurse in charge of dengue field investigations), L. Diéguez (director of cantonal health services)
10.00 – 13:00	Visit of the farm ‘la pampa’ a dairy farm where also show horses are kept
14.30 – 15.30	Visit of the Hagnauer Foundation Las Pumas, Cañas

Wednesday, 4.03.09

9.30 – 11.00	Seminar ‘One world - one health’ given by Paul Gibbs
11.00 – 13.00	Meeting with SENASA, B. Calvo (database specialist), M. Jímenez (communication specialist), A. Sardi, B. Leon and R. Vindas
13.00 – 14.30	Meeting with J. Calvo (coordinator CITES, Ministry of Environment)
14.30 – 16.00	Meeting with Ms. S. Trelles (representative from IICA, Instituto Interamericano de Cooperación para Agricultura)

Thursday, 5.03.09

8.30 – 9.45	Meeting with X. Coronado (OIRSA, Organismo Internacional Regional de Sanidad Agropecuaria)
9.45 – 11.30	Meeting with R. Del Aguila (PAHO, Organización Panamericana de la Salud)
Split team	
11.30 – 13.30	Meeting with C. Jímenez (director of the veterinary school, National University), L. Araya and M. Herrero (entomologist)
11.30 – 13.00	Meeting with Maria Ethel Trejos Solarzana, Head of MinSa Surveillance Unit, José Luis Garces Fernandes, Henry Wasserman, Carlos Alfaro Rojas, and Roberto Del Aguila, 13.30 – 15.30 Wrap up meeting with J. Vicente (Chief Veterinary Officer)

Friday, 6.03.09

9.00 – 10.00	Meeting with E. Hoffman (USDA, APHIS)
11.00 – 12.00	Meeting with Ms. D. Wälchli (Swiss Embassy)
12.30 – 13.00	Meeting with B. Leon, A. Sardi and R. Vindas (SENASA)