Bat Rabies Webinar

**Date:** November 2 Friday AM  
**Location:** Buenos Aires  
**Time:** 08:45 - 12:30h  
**Length:** Each talk will be 15-25 minutes with questions and a final discussion with Q&A at end.  
**Objective:** The purpose of this Webinar is to provide a global overview of bat rabies with a focus upon its epidemiology, prevention and control in a One Health context.  
**Titles and Speakers:**
1. Introduction - Bats, Rabies and Lyssaviruses: an Introspective, **CE Rupprecht VMD**, MS,PhD 08:45h  
3. The overlooked role of serology in bat lyssavirus surveillance. **Susan M. Moore**  
   **SHORT BREAK**  
5. IS THIS ANY ALTERNATIVE TO MANAGE RABIES TRANSMITTED BY BATS IN THE AMERICAS? **Luis Lecuona**  
7. Challenges and Strategies for Bat Rabies Control and Prevention. **James A. Ellison**  
**Discussion by all & Group Q&A**
Bats, Rabies and Lyssaviruses: an Introspective

CE Rupprecht VMD, MS, PhD
LYSSA LLC

Rabies is the oldest known zoonosis of bats. As such, an operational definition of rabies is an acute progressive encephalitis caused by a lyssavirus. To date, more than 17 putative species of lyssaviruses have been characterized, most recently in Eastern Asia and Northern Europe. However, exactly when, where and how lyssaviruses originated remains a mystery. Today, bats are recognized as major lyssavirus reservoirs at a global level. Human, domestic animal or other wildlife cases have been associated with bat lyssaviruses in Africa, the Americas, Australia and Eurasia. Rabies virus is the most significant lyssavirus species, but bat rabies viruses have only been described from the New World. With the prevention and control of canine rabies, most human cases in the Americas are now related to rabid bats. However, rabies is uncommon in bat populations and myths continue to be promulgated against these unique volant mammals. For example, bats are not “carriers”. Rather, multiple bat populations demonstrate herd immunity against various lyssaviruses. Importantly, lyssaviruses are transmitted primarily via a bite and merely seeing or touching a bat is not considered an exposure. Bats that bite humans should be euthanized and sent for laboratory testing. Prompt and proper postexposure prophylaxis with modern biologics will virtually assure survival after exposure to a rabid bat. Other lyssaviruses of bats may require a non-traditional approach towards development and production of future biologics for an ideal comprehensive prevention program in human and veterinary medicine.
Rabies surveillance in bat populations in France: presence of three lyssavirus species

Evelyne Picard-Meyer, Alexandre Servat, Florence Cliquet

Rabies surveillance in bats in France is based on a passive surveillance system. It relies on the submission of bats by the general public, veterinarians, and mainly the French national bat conservation network (SFEPM). The surveillance is based on the testing of sick or found dead animals including bats: bats associated with human contamination are submitted to the National Reference Center (IP Paris) whereas bats without human contamination are submitted for rabies testing to the National Reference Laboratory (ANSES Nancy).

After the first EBLV-1 case reported in a serotine bat (Eptesicus serotinus) in 1989 in North-Eastern France, 81 autochthonous rabies cases have been reported throughout France during a 29-year period, with 64 cases without human contamination’s history. Bat rabies cases are attributed in Europe to 5 different lyssavirus species (EBLV-1, EBLV-2, BBLV, WCBV and LLEBV). Of the 5 reported species, 3 have been detected in bats in France (EBLV-1, BBLV and LLEBV) with most cases reported in Serotine bats (EBLV-1, 78 cases), followed by Natterer's bat (BBLV, 2 cases) and recently one Schreibers' Bent-winged bat found infected by the most genetically divergent lyssavirus (LLEBV).

In June 2017, a Schreiber’s bat found dead was diagnosed positive for the presence of antigen, infectious virus and viral RNA by classical virological methods and molecular methods, respectively. The analysis of the full genome sequence determined by next-generation sequencing confirmed the presence of LLEBV in the Schreiber’s bat with 99.7 % of nucleotide identity to the Spanish LLEBV strain (KY006983). The dead bat was found in the beginning of summer in Eastern France in an underground site. The roost hosting the bat colony in which the infected bat was found, hosted a mixed maternity colony comprising three different species, M. schreibersii, Myotis myotis and Rhinolophus euryale. This roost site houses one of the biggest maternity colony of Schreiber’s bats in France (~ 2,000 individuals). This founding represents the second LLEBV case in European bats, the first one being reported in the Lleida City in Spain some 750 km from the city of isolation in France. This discovery raises questions about the real distribution of LLEBV in bats, particularly in southern France, which hosts most of France’s population of M. schreibersii. Although bats and their roosts are protected by national and European legislation, European bats are endangered. Epidemiological studies show that the population of Serotine bats and Schreiber’s bats are decreasing in France (http://www.plan-actions-chiropteres.fr/IMG/pdf_PNA-Chiropteres-2016_2025.pdf). Within the Third national action plan for bats (2016-2015) initiated in France following the
request of the Ministry of Environment for the study and the protection of bats, health monitoring of bats by passive surveillance has been included in the work plan. Pursuing sanitary surveillance in bats is important to determine the distribution and prevalence of bat lyssaviruses but also to determine causes of mortality in bats.
The overlooked role of serology in bat lyssavirus surveillance

Susan M. Moore
Kansas State University, College of Veterinary Medicine, Veterinary Diagnostic Laboratory, Manhattan, KS

Bats have a unique role in the spread of rabies throughout the world. Bat species diversity, coevolution with multiple viruses affecting humans, and factors driving intra and interspecific transmission of bat viruses all contribute to the complexity of surveillance of lyssavirus in bat populations. Surveillance techniques typically involve capture of representative numbers of a colony and sampling saliva for lyssavirus isolation and detection of viral nucleic acid, and secondarily, sampling blood for the presence of lyssavirus specific antibodies. The results will then indicate the percentage of currently infective individuals and those previously exposed or infected with lyssaviruses, both of which provide evidence of the extent of lyssavirus circulation in the colony. However, the immune systems of bats have been found to have interesting differences with other mammals, such as kinetics and magnitude of antibody responses, isotype switching and mechanisms of affinity maturation as well as a unique interferon system. Failure to detect specific antibodies may be insufficient to conclude there is no evidence of prior exposure. The role of rabies serology used as a tool for rabies vaccine response surveillance has been established and in use for many years, with recognized limitations. Use of these methods for surveillance of circulation of the lyssavirus virus and disease in sylvatic populations, while employed in previously published research, would benefit from an examination of fit for purpose. Especially for lyssavirus surveillance in bats which compromise a larger diversity of lyssavirus species. Greater understanding of factors in bats directing antibody production and decline and selection of the proper serology assay will aid in the use of serology as a tool for lyssavirus surveillance in bats globally.
Bats in the Belfry, Eh? - An Exploration of Rabies in Canadian Chiroptera

C. Fehlner-Gardiner and S. Nadin-Davis
Canadian Food Inspection Agency

There are nineteen insectivorous bat species indigenous to Canada and they differ in geographical distribution as well as ecology. As elsewhere in the Americas, bats in Canada serve as reservoirs of rabies virus, and as programs for the control of rabies in terrestrial wildlife have developed since the mid-1990s, on an annual basis bats frequently represent the species most commonly diagnosed with rabies in Canada. Since 1968, all indigenously-acquired human rabies cases have been the result of bat exposures. This talk will explore the diversity of bat species in Canada and the use of barcoding methods for accurate host species identification of diagnostic submissions. This tool, together with molecular epidemiological analysis of bat-associated rabies viruses, has provided a comprehensive understanding of the large variety of rabies virus variants that circulate in Canadian bats and their maintenance by particular host species. In recent years, white nose syndrome has had a significant impact on bat populations in much of eastern Canada and it remains to be seen if this will result in extermination of some bat rabies virus variants. The impacts of bat rabies on public and animal health in this country will be discussed.
IS THIS ANY ALTERNATIVE TO MANAGE RABIES TRANSMITTED BY BATS IN THE AMERICAS?

Luis Lecuona

USDA, APHIS, International Services, Wildlife Program, Mexico City, Mexico

From the 1,200 known species of bats, America is the only continent inhabited by the species that feed on blood. Many countries in the Continent, from Mexico to Argentina have presence of the three species of haematophagous bats. For example, from more of 150 species of bats living in Mexico, only three are haematophagous: the “common vampire” or Desmodus rotundus, the “white-winged vampire” or Diaemus youngi and the “hairy-legged vampire” or Diphylla ecaudata. Of these, only one, the “common vampire”, primarily feeds from the blood of mammals. All three species use caves, hollow trees and abandoned mines as shelters. They prefer a constant climate of 22 degrees Celsius and 45 percent humidity, but have been adapted to other environmental conditions, such as semi-desert. On the other hand a growing number of cases of rabies in non-haematophagous bats, especially insectivorous as Tadarida brasiliensis and “Eptesicus fuscus” or frugivores as “Sturnira lilium” and “Rousettus aegyptiacus” is reported in several countries in the Americas. It is common to observe that at least two of those species are able to share refuges and stay in small colonies and it helps to understand the relation among the rabies virus variants reported in these bat species. About the vampire bats, they are commonly carriers of rabies and they could transmit the disease to warm-blooded animals, both wild and domestic when they go in search of food and occasionally to the humans exposed in these areas. In that case, the main part of the countries in Latin America have established their own plan based on the control strategies developed by Mitchell, Flores Crespo and Arthur Greenhall on late the 60’s and early the 70’s. The consistency and efficacy of these procedures are under permanent discussion but no other efficient plan to reduce the impact is yet in place to substitute these procedures. When rabies is transmitted by non-haematophagous bats, the epidemiological surveillance, the early monitoring and the community communications play an important role to reduce the risk in human and other domestic animals, specially pets that makes necessary a very efficient coverage of rabies vaccination in those animals in the detected risk areas where the occurrence of rabies in these bats represents a high priority concern. On the other hand, several species of non-haematophagous bats are essential for the ecological equilibrium and are considered protected species, then any direct intervention to reduce the rabies presence in these animals is not considered at this end. Several worldwide efforts are in place to integrate efficient plans to manage the risk of rabies in bats. Applied research, high quality diagnostic, permanent epidemiological surveillance and community communication are the keys for a better understanding of the problem.
Rabies in Bats in Latin America: Spillover and Rabies Secondary Transmission

Ivanete Kotait

Bats are one of the main reservoir for Lyssavirus worldwide constituting an important public health issue. Bats and Viruses have a complex relationship and different RABV variants are maintained in these animals. **Vampire bats:** In Latin America the common vampire bat Desmodus rotundus is a primary reservoir of rabies, a zoonotic virus that kills thousands of livestock annually and causes sporadic lethal human rabies outbreaks. Although rabies is endemic in vampire populations, there is limited research on the extend of exposure to bats among human populations living near bat refuges. The high dispersal capacity of males of Desmodus rotundus may explain the wider circulation of rabies virus and the ineffectiveness of bat populations controls. In the Amazon Region (Ecuador, Colombia, Venezuela and principally in Peru and Brazil) the absence of livestock was associated with feeding on humans and wildlife. It’s necessary to analyze the bat rabies surveillance data and risk factors for rabies with human cases in these countries and to study pre-exposure rabies scheme to communities at risk. The incidence of the human rabies in the Amazon area will be presented.

**Frugivorous Bats:** The great fruit eating bat (Artibeus lituratus) was reported with abnormal behavior and was characterized as infected with RABV, and it is believed that this infection represented spillover from vampire bats species. When the comparison with the infection of numerous insectivorous bats species and the cases of human rabies was made, the significance of rabies in frugivorous bats in South America is small. **Insectivorous bats:** RABV has been characterized in only a small proportion of recognized species. However, in recent years much more species of insectivorous bats were recognized with RABV, antigenic and genetic studies were accomplished, but the real distribution of these variants hasn’t been established. Some countries have large population of bats, like Tadarida brasiliensis and Nyctinomos spp, as well as other different species, and these are the most important reservoir from RABV.
Challenges and Strategies for Bat Rabies Control and Prevention

James A. Ellison
Poxvirus and Rabies Branch, Division of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention 1600 Clifton Rd. NE, Mailstop H23-4, Atlanta GA, 30329, email: JEllison@cdc.gov

Rabies is an ancient viral disease that emerged from bats. First documented in bats in 1936 in South America, subsequently rabies was detected in US bats in 1953. Since then, active and passive surveillance has steadily increased, resulting in the identification of countless pathogenic and divergent bat Lyssaviruses around the world. Disease emergence typically requires a precipitating factor, one that promotes the probability or success of pathogen spillover from a natural host to an auxiliary host. Such precipitating factors could be changes to the agent, the host, or the environment. Human population expansion has artificially increased animal densities, thereby increasing the contact between humans and animals. Rabies provides the classical example of the way in which bats are perceived to have a negative impact on public health. But rabies also offers opportunities for developing an evidence base for understanding parameters related to pathogen transmission and pathogen perpetuation and divergence in populations, and multi-host communities. Mass vaccination campaigns targeting canines and terrestrial reservoirs have been effective in reducing the incidence of rabies among carnivores, but are not appropriate for use in bats. Currently no strategies aimed at decreasing virus circulation within bats have been proposed. Two important questions remain unanswered, what makes bats exceptionally good viral reservoirs, and why it appears that only bats in the Americas maintain transmission cycles? The development and application of appropriate research tools will provide opportunities for comparisons of virus-host interactions during natural and experimental infections in bats and other mammals, and may identify biomarkers needed to detect rabies in bats before clinical signs manifest. Such multi-disciplinary studies require improvement of basic knowledge in bat ecology, physiology, immunology, virology, and genomics, among others. This presentation provides a multidisciplinary forum for discussing the remarkable physiology and natural life history traits of bats and proposes novel strategies for rabies management in this unique reservoir.