



The One Health Newsletter is a collaborative effort by scientists and health professionals from the following organizations:

- Palm Beach County Health Department
- Florida Department of Health
- University of Florida
- University of South Florida
- Kahn/Kaplan/Monath One Health Team



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*This newsletter was created to lend support to the One Health Initiative and is dedicated to enhancing the integration of animal, human, and environmental health for the benefit of all.*

## Emerging Pathogens Institute, University of Florida

**J. Glenn Morris Jr., MD, MPH & TM**

The State of Florida funded the creation of the University of Florida (UF) Emerging Pathogens Institute (EPI) in 2006, based on the recognition that our state is one of the most susceptible in the U.S. to new infectious diseases that hold the potential to harm not only our citizens, but also our diverse wildlife, agricultural sectors, and economy. At EPI, we fuse key disciplines within the University, as well as beyond our campus's footprint, in order to track and study emerging pathogens globally, perform interdisciplinary research to devise early diagnostics, and integrate novel scientific research into policy recommendations. Researchers working with EPI are housed in eight of University of Florida's major colleges: Veterinary Medicine, Medicine, Liberal Arts and Sciences, Public Health and Health Professions, Engineering, Pharmacy, Dentistry, and Agricultural and Life Sciences. We are the only Institute in the U.S. to unite all of these academic professional and research programs within one pathogen-focused institution.

In August 2009, we will move into our new 80,000-square foot pathogens facility on UF's campus. Our new building includes extensive BSLII laboratory space, as well as 16 BSLIII modules; a floor and a half dedicated to bioinformatics and biomathematics; rooftop BSLIII greenhouses for work with plant pathogens requiring isolation; and office space for researchers and students. (For more information, please visit: <http://www.epi.ufl.edu>).



**The Emerging Pathogens Institute's new facility is scheduled for completion by August 2009.** Co-located on the University of Florida campus with the Cancer and Genetics Research Complex, the new four-story building will provide much needed lab spaces to link researchers across campus.

While EPI is still very much a "work-in-progress," certain areas of expertise have emerged. At UF, we have traditionally had great strengths in research on vector-borne diseases, combining expertise from the Department



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of Infectious Diseases and Pathology in the College of Veterinary Medicine; the Florida Medical Entomology Laboratory in Vero Beach and the Department of Entomology in the Institute of Food and Agricultural Sciences (IFAS); and the UF Whitney Laboratories.

This expertise is further enhanced by the USDA/ARS Center for Medical, Agricultural, and Veterinary Entomology (CMAVE), which is adjacent to the UF campus. Currently, EPI and its collaborators are involved in projects on malaria, West Nile, equine encephalitis, other veterinary vector-borne diseases such as blue tongue, and the devastating agricultural disease citrus greening (thought to be caused by the fastidious bacterium *Candidatus Liberibacter asiaticus*, spread by Asian citrus psyllids). In conjunction with the CDC-funded Southeastern National Tuberculosis Center, EPI has placed a strong emphasis on tuberculosis and other mycobacterial diseases, including studies of multi-drug resistant mycobacterial strains. Working with IFAS and with the UF Water Institute, EPI has also promoted programs in food and water-borne diseases, with continuing research on enteric and other diarrheal pathogens, including cholera.

At EPI we feel strongly that studies of emerging pathogens can only be conducted in a global context: pathogens do not recognize state or national borders, and, with the burgeoning of global transportation systems, diseases can jump rapidly from one part of the world to another. We believe in working abroad and studying novel diseases, the evolution of their virulence, and their transmission pathways --- before they reach our shores in the U.S. In this context, EPI has projects on malaria and diarrheal disease in sub-Saharan Africa, plague in the Republic of Georgia, and tuberculosis in Morocco and the Dominican Republic, as well as strong ties with institutions such as the National Institute for Cholera and Enteric Diseases in Kolkata and the International Center for Diarrheal Diseases Research in Dhaka. Climate change presents another challenge to Florida, and to the global community: as the traditional weather patterns of some geographic locations alter and warm, the species composition and ecology may change, opening niches for novel infectious diseases to emerge and possibly become established. Through EPI, we have initiated an interdisciplinary program in Changing Environments and Emerging Diseases to encourage further work in this area.

We encourage health professionals, medical doctors, veterinarians and researchers external to UF to explore our website, [www.epi.ufl.edu](http://www.epi.ufl.edu) and consider joining our list-serves; membership is free and offers access to funding opportunity notices and news. We also encourage scientists to explore our Member directory to identify investigators who may be working on related projects. We encourage an interdisciplinary approach to studying, tracking, containing and eradicating novel and emerging pathogens, and look forward to working with investigators with similar interests as our Institute grows and matures.

***Dr. J. Glenn Morris Jr. is the director of the University of Florida's  
Emerging Pathogens Institute***



## One Health Joint Steering Committee Update

**Carina Blackmore, DVM, PhD**

The One Health Joint Steering Committee (OHJSC) held its 2<sup>nd</sup> meeting in Washington, DC on March 5, 2009. The main purpose of the Committee is to create a One Health Commission. The Commission will complete the implementation of the recommendations of the OHIT

(<http://www.avma.org/onehealth/recommendations.pdf>) over a three-to-five year period. The Taskforce report was discussed in detail in our July 2008 edition of the Newsletter

([http://www.doh.state.fl.us/Environment/medicine/One\\_Health/OneHealth.html](http://www.doh.state.fl.us/Environment/medicine/One_Health/OneHealth.html)).

The Rockefeller Foundation has contributed \$100,000 to the OHJSC towards establishing the One Health Commission. A press release to announce the grant was distributed on March 5

([http://www.avma.org/press/releases/090305\\_Rockefeller\\_grant.asp](http://www.avma.org/press/releases/090305_Rockefeller_grant.asp)).

The funds have been used to hire an OHJSC Project Director, Dr. Roger Mahr. Among his many accomplishments prior to becoming the OHJSC Project Director, Dr. Mahr served as the president for AVMA, and also represented the organization on the One Health Initiative Task force and the OHJSC. A new AVMA representative to the OHJSC has not yet been named. Dr. Roger Mahr assumed his role as project director on Jan 23.

An OHJSC One Health Commission Formation Working Group has been established to start the development of a One Health Commission Advisory Team, refine the current One Health Initiative business plan and provide access to potential financial support. The Advisory Team, One Health leaders and experts across the country, will assist with the development of the operational structure of the One Health Commission. The current target date for launch of the Commission is July, 2009. Voting member organizations of the OHJSC will be invited to join as members.

- A draft roster with current members of the OHJSC is available at: [http://www.doh.state.fl.us/Environment/medicine/One\\_Health/OHJSCDraftRoster.pdf](http://www.doh.state.fl.us/Environment/medicine/One_Health/OHJSCDraftRoster.pdf)
- A One Health Commission website will be launched later this spring.
- A one-day One Health Summit is tentatively planned for this fall in Washington, DC.

**The One Health Joint Steering Committee is scheduled to meet again on May 6, 2009.**

***Dr. Carina Blackmore is Chair of the One Health Initiative Steering Committee's communications workgroup, a member of the One Health Newsletter editorial board, and Florida's State Public Health Veterinarian.***



*The Rockefeller Foundation has contributed \$100,000 towards establishing the One Health Commission.*



**Carina Blackmore**  
Chair of the  
Communications Workgroup

*The current target date for launch of the Commission is July, 2009.*

## **Giardia: Don't Let That Smile Fool You!**

Albert L. Vincent, Ph.D. and John N. Greene, MD



**Figure 1.** *Giardia intestinalis*

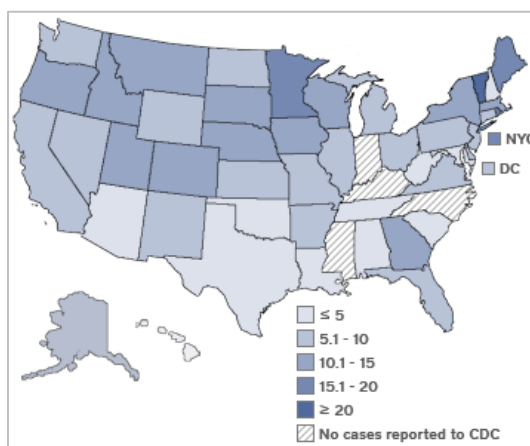
*Giardia is a protozoan flagellate that parasitizes both humans and animals. The parasite lives in the intestine and is passed in feces.*

*Because the Giardia is protected by an outer shell, it can survive outside the body and in the environment for long periods of time.*

*Incidence rates vary more than four-fold by state and some northern states experience relatively high transmission.*

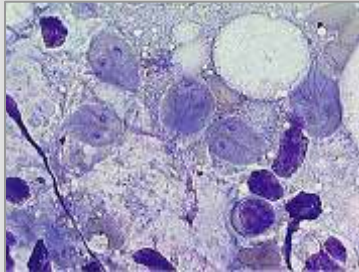
*Giardia* is a fascinating parasite. This duodenal flagellate was first discovered in 1861 by the pioneering Dutch microscopist Antony Van Leeuwenhoek in his own stool. In correspondence to Robert Hooke he recounted ...." *animalcules a-moving very prettily. Their bodies were some longer than broad, and their belly, which was flatlike, furnisht with sundry little paws...yet but for all that they made but slow progress*". In stained fecal smears, the symmetrical, pyriform trophozoite (10-20  $\mu$ m in length) presents an unforgettable "little monkey face". Two large round eye-like nuclei enclose prominent nucleoli, while curved median bodies lend the appearance of a cockeyed smirk. The large ventral disc provides tight adherence to the duodenal mucosa. Lacking many organelles, *Giardia* is one of the most primitive eukaryotes. Giardiasis is associated with drinking water from unfiltered surface sources or shallow wells, swimming in bodies of fresh water, or having a young family member in daycare. Food handlers and oral/anal sex are other routes of transmission. Cysts withstand chlorinated water, boiling water at high altitudes and can endure cold water for months. Prevention includes proper disposal of human wastes, careful hand washing, filtration of water supplies, and safe sex practices.

About half of those who are exposed become asymptomatic carriers. Others, left untreated, may progress to weeks or months of recurrent watery diarrhea, passing frothy, mushy stools. Severe giardiasis may present with anorexia, flatus, bloating, sulfur belching, substernal burning, and steatorrhea whose characteristic odor is not soon forgotten.....so don't let the smiley face of that trophozoite fool you (Figure 1). Chronic enteritis leads to duodenal malabsorption, debilitation, weight loss, and failure to thrive. Predisposing diseases include HIV/AIDS, cancer chemotherapy, cystic fibrosis, and hypogammaglobulinemia. Both symptomatic and asymptomatic cases should be treated with oral metronidazole 250 mg thrice daily for 5 days or oral tinadazole 2 gm for one dose; alternatively, consider oral nitazoxanide, 500 mg twice daily for 3 days. No vaccines for humans are likely to appear soon.



**Figure 2.** Reported *Giardia* Incidents per 100,000 Population, 1998 -2002. MMWR Surveill Summ. 2005 Jan 28;54(1):9-16.

*Giardiasis in humans is a reportable disease in the US.*



**Figure 3.** Fine needle aspirate from a dog with diarrhea, hypogammaglobulinemia, hypoalbuminemia, and ascites.

**Note** *Giardia* trophozoites, cuboidal epithelial cells, mucus, fat, and small lymphocytes.

*Annual screening is indicated for giardiasis and other enteric parasites in companion animals.*



*Beavers are thought to be a major reservoir host endangering public drinking water supplies in the Rocky Mountains.*

Giardiasis in humans is worldwide and is reportable in the US. Incidence rates vary more than four-fold by state and some northern states experience relatively high transmission (Figure 2). Nationally, endemic infections peak during the warm months between July and October, presumably reflecting seasonal exposure to contaminated water. The age-specific incidence of cases reported per 100,000 residents in this country exhibits a bimodal distribution, with a major peak in infants and toddlers 1-2 years of age followed by a lesser crest at 25-39 years, probably resulting from exposure of child care givers. Notifiable disease surveillance data from the state of Florida are consistent with these findings. Of 9679 cases reported between the years 2000 and 2007, 41.5% were infants and children 1-9 years of age and 26.5% were between the ages of 30-49 years. Notably, infants and toddlers 1-4 years of age accounted for more than a quarter of all cases.

Annual or semiannual screening is indicated for giardiasis and other enteric parasites in companion animals. Canines from puppy mills should be examined immediately on that basis. Because shedding of cysts is irregular, a negative O & P should be repeated after several weeks. Antigen capture is highly sensitive and specific but allows pathogenic coccidians of cats to escape detection. A positive result from either test is a basis for treatment. Diarrhea in adult dogs can frequently be traced to dietary indiscretion. While less common in cats, diarrhea is often due to adverse food reactions. Under the stress of overcrowding, *Giardia* produces epidemic diarrhea in dogs and puppies (Figure 3), infecting 100% of kennel dogs. Surveys have found infection in 14% of adult dogs and in 30% of puppies less than one year of age. Its pathogenicity in sporadic cases of enteritis is unclear. Giardiasis in companion animals may be acquired by coprophagy, anal licking, or by drinking contaminated surface water. Owners should be advised to drain and disinfect exposed peridomestic surfaces with Lysol or compounds which contain quaternary ammonium.

Dogs and cats which test positive should be treated with metronidazole, 15 mg/kg bid for a total of seven days. If apparent resistance is encountered, follow up with fenbendazole 50 mg/kg qd x seven days. If diarrhea continues to persist in a cat or puppy, *Cryptosporidium* should be suspected. A subcutaneous vaccine for giardiasis, produced from trophozoites isolated from sheep, is available in North America. Experimentally inoculated puppies and kittens subsequently challenged with live *Giardia* were protected from clinical disease and excreted fewer or no parasites. As yet, however, the vaccine has not found its way into mainstream veterinary practice here.

Of seven genotypes/assemblages of *Giardia duodenalis* (syns. *G. lamblia*, *G. intestinalis*), humans are host to only genotypes A and B. Both are shared with dogs. Two canine genotypes not shared with humans are C and D. Cats share only one genotype with their owners (A) and are the sole occupants of genotype F. Three major cycles of transmission are recognized, human, herbivore, and zoonotic. Evidence to support some degree of zoonotic transmission to humans is strong, but how frequently such transmission occurs and under what circumstances is an illusive issue. A reasonable consensus is that beavers (*Castor canadensis*) (Figure 4) are one major reservoir host endangering public



**Figure 4.** Beaver  
(*Castor Canadensis*)

*The role of the veterinary practitioner is to educate his clients on the importance of regular screening and on prevention of giardiasis in their companion animals.*

drinking water supplies in the Rocky Mountains but that herbivores are generally of little significance.

The greatest total risk of zoonotic transmission to humans appears to stem from their companion dogs and cats. Again, however, the individual risk is probably quite small and evidently varies by geographic location. The role of the veterinary practitioner is to educate his clients on the importance of regular screening and on prevention of giardiasis in their companion animals. While epidemiological issues remain unresolved, it is nevertheless sound practice to also advise pet owners, particularly those at known risk, that giardiasis may cause disease in both humans and in their pets. Symptomatic or otherwise, companion animals that test positive for giardiasis should receive prompt treatment from a veterinarian.

#### References

- Ali SA, Hill DR. Curr Opin Infect Dis. 2003 Oct; 16(5):453-60. *Giardia intestinalis*.  
 Adam RD. Biology of *Giardia lamblia*. Clin Microbiol Rev. 2001 Jul; 14(3):447-75.  
 Xiao L and Fayer R. Molecular characterization of species and genotypes of *Cryptosporidium* and *Giardia* and assessment of zoonotic transmission. International Journal for Parasitology. 2008. [www.sciencedirect.com](http://www.sciencedirect.com)

**Our thanks to Harold Jones, DVM and to David Atrubin, MPH**

***Dr. Albert L. Vincent is an associate professor in the Division of Infectious Diseases and International Medicine at the University of South Florida in Tampa.***

***Dr. John N. Greene is Chief of Infectious Diseases and Epidemiology at H. Lee Moffitt Cancer Hospital & and Research Institute in Tampa***



## ***Cryptococcus gattii: An Emerging Fungal Pathogen in the Pacific Northwest***

**Dr. Ron Wohrle, DVM**

*Cryptococcus gattii*, a basidiomycete fungus, emerged as an environmental fungal pathogen on Vancouver Island, British Columbia (BC) in 1999. Most *C. gattii* cases in BC were diagnosed in people or animals that lived in or had visited the southeast coast of Vancouver Island. The presence of *C. gattii* in specific regions of Vancouver Island affected residents, visitors to the island, and animal populations. Domestic and wild animals affected included dogs, cats, llamas, horses, ferrets, pet birds, and porpoises.

A number of infections in people and animals with no travel history to *C. gattii* endemic areas have since been confirmed on the BC mainland, as well as in Washington and Oregon states. These infections provide evidence that *C. gattii* is expanding its range within the Pacific Northwest.

Prior to its appearance on Vancouver Island, *C. gattii* was generally thought to be endemic only in tropical and sub-tropical regions of the world,



**Vancouver Island**



*Cryptococcus gattii* emerged as an environmental fungal pathogen in the Coastal Douglas Fir and Western Hemlock biogeoclimatic zones of the Pacific Northwest in 1999.



Unlike other *Cryptococcus* species, *C. gattii* commonly causes disease in people or animals that are otherwise healthy with a normally functioning immune system.

including Australia, South America, Mexico, parts of Asia, and California. It was almost always associated with certain species of eucalyptus trees. Environmental investigations on Vancouver Island found *C. gattii* spores on a variety of native trees as well as in soil, fresh and salt water, and in the air. Studies have since shown that the distribution of *C. gattii* is focused along the southeastern region of the island in the Coastal Douglas Fir and Coastal Western Hemlock biogeoclimatic zones.

These two zones stretch along the eastern edge of Vancouver Island and are characterized by warm, dry summers, and mild, wet winters. Both zones extend into the southern Gulf Islands and the southern BC mainland. Similar biogeoclimatic zones with comparable rainfall and temperature extend farther south into parts of western Washington and Oregon. Likewise, plant communities similar to those in BC have been identified in the San Juan Islands and Puget Trough of Washington and the Willamette Valley in Oregon. These ecologic similarities to BC support the idea that *C. gattii* is able to successfully colonize niche areas of the US Pacific Northwest.

Since its discovery in 1999 and through 2006, 176 people in BC have been confirmed infected with *C. gattii*, with eight cases proving fatal. The majority of cases were exposed on the eastern coast of Vancouver Island where the incidence of *C. gattii* infection is 36 cases/million population, compared to an annual provincial incidence of 6/million among all BC residents. Since 2006, nine people in Washington have been diagnosed with *C. gattii*. Although it is unclear where some of the people may have contracted the disease, careful case investigations indicate that some *C. gattii* infections were acquired within Washington state. Since 2004, nine people in Oregon have been reported with *C. gattii*.

*Cryptococcus gattii* is acquired by breathing in airborne spores and may cause lung-related, brain, and spinal cord disease. Activities that disturb the fungal spores in soil or on trees may increase the likelihood of exposure. Disease acquisition may also depend on host factors, including underlying lung conditions and oral steroid use. Unlike other *Cryptococcus* species, *C. gattii* commonly causes disease in people or animals that are otherwise healthy with a normally functioning immune system.

Infection is caused by breathing in the spores of the *Cryptococcus* fungus, but not from contact with an infected person or animal. Symptoms can appear 2 to 12 months after exposure and include a prolonged cough (lasting weeks or months), sharp chest pain, unexplained shortness of breath, fever, night sweats, severe headache, and weight loss.

*Cryptococcus gattii* infection in animals includes a variety of symptoms, including sudden onset blindness, seizures, other signs of central nervous system involvement, respiratory signs (runny eyes, nostrils, enlarged peri-mandibular lymph nodes), and lumps under the skin. Inhalation of *C. gattii* by animals is thought to be followed by nasal cavity colonization that may lead to systemic

*Infection is caused by breathing in the spores of the *Cryptococcus* fungus, but not from contact with an infected person or animal.*



Environmental surveillance for *C. gattii*

*The Centers for Disease Control and Prevention (CDC) facilitated the formation of the West Coast *Cryptococcus gattii* Public Health Workgroup.*



illness. Cats are reportedly four times more likely to be clinically affected based on the BC outbreak information. In BC, 60 percent of companion animal cases showed neurological symptoms.

### Washington *C.gattii* Animal Cases 2005-2008



Environmental surveillance in Washington began in 2005. Approximately 50 samples were collected in Whatcom County, within six miles of the BC border. Two samples, including a single soil sample and a swab sample from a wood fence post tested positive for *C. gattii*. Both of these samples were collected near the residences of two cats with confirmed diagnoses of *C. gattii* infection.

Recognizing the importance of this emerging fungal pathogen in the Pacific Northwest, the Centers for Disease Control and Prevention (CDC) facilitated the formation of the West Coast *Cryptococcus gattii* Public Health Workgroup. This group consists of various federal, international (British Columbia UBC BCCDC), state, and local public health practitioners, laboratorians, and academicians from six western states (Washington, Oregon, California, Idaho, Montana, and Alaska). The workgroup's first meeting, co-sponsored by the Washington State Department of Health and the CDC, was held in Shoreline, Washington in November 2008. In addition to facilitating this workgroup to coordinate information sharing among the various agencies, CDC awarded funding to Washington and Oregon to enhance surveillance efforts.

Funding for *C. gattii* environmental and animal surveillance in Washington enabled Washington State Department of Health's Zoonotic Disease Program staff to conduct environmental case investigations that included environmental sampling near the residences of animals with a confirmed diagnosis of *C. gattii*. Funding also allowed veterinary pathologists to conduct molecular typing of *Cryptococcus* species, allowing them to distinguish *C. gattii* from other species of *Cryptococcus*. Nine animals were confirmed with *C. gattii* in 2008, but no positive environmental samples were found.

Veterinary reporting is a critical component of Washington's *C. gattii* surveillance project. Veterinarians are often the first to detect unusual pathogens that can be shared by humans and animals, highlighting the importance of animals



*Veterinary reporting is a critical component of Washington's C. gattii surveillance project.....*

*.....Animal cases tend to appear six to twelve months before human cases.*

as indicators of emerging zoonotic pathogens. Published data from studies on Vancouver Island suggest that animal cases of *C. gattii* exceed human cases by almost 75%, highlighting their value as an early indicator of disease in the environment. Additionally, animal cases tend to appear 6-12 months before human cases.

Both animal and human infections with *C. gattii* are reportable in Washington as a rare disease of public health significance. Results of Washington's *C. gattii* surveillance project will provide additional information on the current distribution of *C. gattii* in the Pacific Northwest as well as increased awareness of *C. gattii* among veterinarians as well as state and local health professionals.

**For more information about the C. gattii surveillance project in Washington contact Dr. [Ron Wohrle](#) at 360-236-3369**

***Dr. Ron Wohrle is the Environmental Health Veterinarian in the Zoonotic & Vector-borne Disease Program, Office of Environmental Health & Safety at the Washington Department of Health.***



## Cardiac Pacing Site Optimization

**Amara Estrada, DVM, DACVIM**

### Introduction

The first fully implantable pacemaker was placed in a person in 1958<sup>1</sup>. The first artificial pacemaker implantation in a dog was described by Dr. James Buchanan almost 38 years ago<sup>2</sup>. Since that time, transvenous pacing has become a common procedure performed by veterinary cardiologists in the treatment of complete atrioventricular (AV) block, high grade second degree AV block, sick sinus syndrome, and atrial standstill. It is a minimally invasive surgical procedure with pacing leads most commonly advanced into the right ventricular apical endocardium via surgical cutdown over the jugular vein. Initially, pacemakers were programmed in an asynchronous pacing mode, whereby there was no sensing of inherent beats and no mode of response. The pacemaker simply paced one hundred percent of the time. Following this, pacemakers were created to pace in a ventricular demand mode so that inherent normal beats, as well as premature beats, were sensed by the pacemaker and allowed for inhibition of pacing on top of these beats (Figure 1).

Although this mode of ventricular pacing was better, some patients did not do well after pacing was initiated and had continued syncopal or near-syncopal events, dizziness, and sometimes congestive heart failure. The term "pacemaker syndrome" was coined to refer to a complex of clinical signs and symptoms related to the adverse hemodynamic and electrophysiologic consequences of ventricular pacing. Neurologic symptoms, or those suggesting low cardiac output or congestive heart failure, are indicative of the pacemaker syndrome.



*Transvenous pacing has become a common procedure performed by veterinary cardiologists.*

*Pacemakers were initially programmed in an asynchronous pacing mode and paced 100% of the time.*



*Key concepts of physiologic pacing included proper sequencing of atrial and ventricular contraction and physiologic rate modulation.*

*While single chamber ventricular pacing prevents bradycardia and death from ventricular standstill, dual chamber pacing better emulates normal cardiac physiology.*

**Figure 1.** Example of the typical placement of a transvenous permanent pacemaker.



A small venotomy is made over the jugular vein and a lead is placed in the right ventricular apical endocardium. The lead is then attached to a generator which can be buried subcutaneously in the neck or over the back. The ECG on the top is from a patient with a pacemaker programmed in an asynchronous pacing mode. In this modality, the pacemaker paces at a constant rate without the ability to sense inherent beats and prevent from pacing on top of them, or within the vulnerable period as shown by the circled complexes. These complexes are ventricular premature complexes and in the ST segment there are pacing spikes following by ventricular depolarizations. The bottom ECG is from a patient with a ventricular demand pacing system in which the pacemaker only paces when needed and is able to sense inherent beats and inhibit from pacing during those times periods.

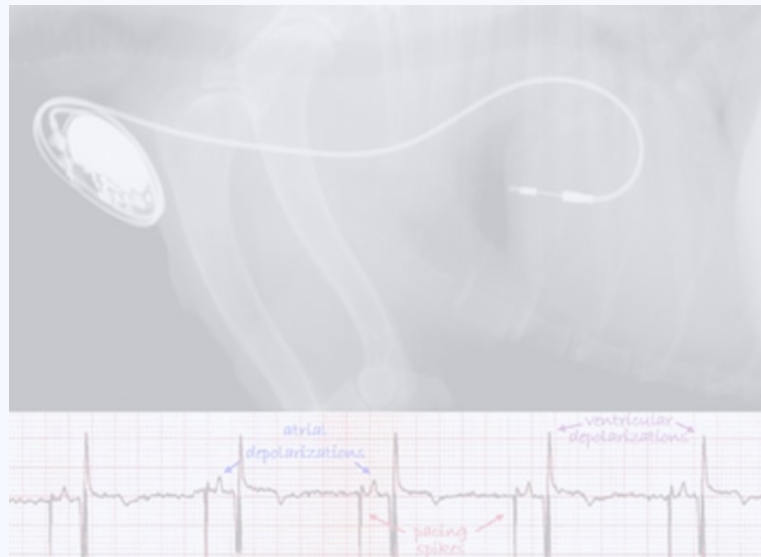
### Physiologic Pacing

Since initial descriptions and development of pacing techniques, technological advances have enhanced the sophistication of cardiac pacemakers. Key concepts of physiologic pacing which were initially identified as causes of the pacemaker syndrome included proper sequencing of atrial and ventricular contraction and physiologic rate modulation. Physiologic rate modulation has allowed patients to have lower heart rates at rest, and higher heart rates with exercise<sup>3</sup>. The importance of atrial contribution to cardiac output has been demonstrated in a variety of patient groups as well as at different heart rates. The restoration of AV synchrony by pacing was branded early on as “physiologic pacing” because it mimics the normal sequence of AV activation. While single chamber ventricular pacing prevents bradycardia and death from ventricular standstill, dual chamber pacing better emulates normal cardiac physiology by restoring AV synchrony and matching the ventricular pacing rate to the sinus rate. Synchronization between the atria and ventricles can easily be accomplished by utilizing atrial leads for patients with sick sinus syndrome and periods of sinus arrest whom have a normal functioning AV node (Figure 2).

*Synchronization between the atria and ventricles can easily be accomplished by utilizing atrial leads for patients whom have a normal functioning AV node.*

*For patients with AV nodal disease, AV synchrony can still be maintained by utilizing dual lead systems whereby one lead is placed within the right atrium and one lead is placed within the right ventricle.*

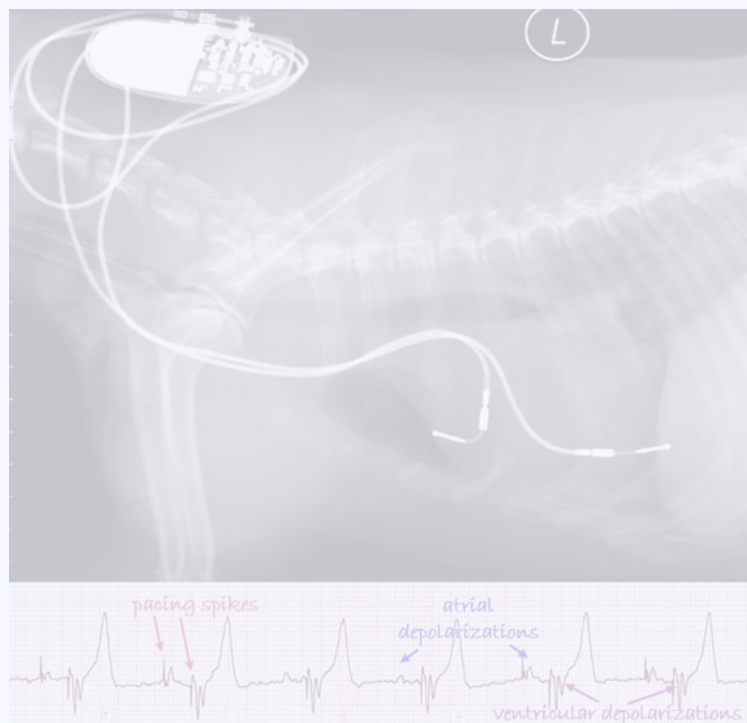
**Figure 2:** Example of a patient with Sick Sinus Syndrome and an atrial based pacing system.



In this situation, the pacemaker delivers an atrial pacing spike causing atrial depolarization. Because the patient has a normal AV node, this atrial depolarization is then conducted through the normal conduction pathway to cause ventricular depolarization.

For patients with AV nodal disease, AV synchrony can still be maintained by utilizing dual lead systems whereby one lead is placed within the right atrium and one lead is placed within the right ventricle (Figure 3). In this situation, both leads are capable of both sensing inherent beats as well as pacing the chamber within which they are located.

**Figure 3:** Example of a patient with Sick Sinus Syndrome and AV nodal disease with a dual chamber pacing system.



There is one lead within the atrium that is able to both pace and sense, and a second lead in the right ventricle that is also able to pace and sense. This ECG shows some native p waves that are sensed by the pacemaker and a ventricular pacing spike delivered in response.

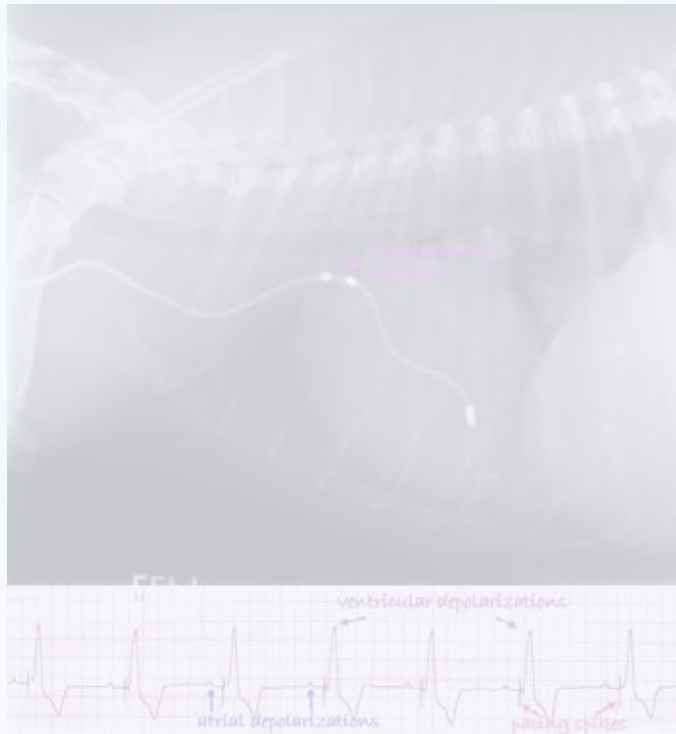
Dual chamber pacing can also be accomplished using a single lead system which utilizes a floating atrial electrode within the right atrium and a

*Dual chamber pacing can also be accomplished using a single lead system which utilizes a floating atrial electrode within the right atrium and a ventricular pacing electrode within the right ventricular apical endocardium.*

*AV synchrony improves stroke volume, raises systolic blood pressure, reduces right atrial pressure and pulmonary capillary wedge pressure, and is less likely to elicit cardioinhibitory reflexes.*

ventricular pacing electrode within the right ventricular apical endocardium (Figure 4). This system allows for sensing of inherent sinus node depolarizations (p waves) and delivers a ventricular pacing impulse in response. Maintenance of AV synchrony by using either dual chamber pacing systems or atrial pacing systems have reduced clinical symptoms and improved quality of life in people with complete AV block<sup>3</sup> and sick sinus syndrome<sup>4</sup> and offers significant improvement as compared with single chamber ventricular pacing. In short and long term studies, AV synchrony improves stroke volume, raises systolic blood pressure, reduces right atrial pressure and pulmonary capillary wedge pressure, and is less likely to elicit cardioinhibitory reflexes than is single chamber ventricular pacing.

**Figure 4:** Example of a patient with a single lead, dual chamber pacing system.



This lead has a floating atrial electrode that is able to sense native p waves. Once p waves are sensed, a ventricular pacing spike is delivered and causes ventricular depolarization in response to the underlying sinus rate.

Despite the ability to restore physiologic heart rates and maintain AV synchrony in patients with bradyarrhythmias, there is still much to be improved upon with current pacing techniques. This has forced the pacing profession to rethink what is meant by “physiologic pacing”. The traditional pacing site, the right ventricular apex (RVA), allows for easy endocardial placement of leads but is now considered to be one of the worst sites for pacing by human electrophysiologists<sup>5-9</sup>. During normal sinus rhythm or during atrial pacing, impulse activation of the ventricles is characterized by minimal asynchrony, earlier left ventricular (LV) than right ventricular (RV), and earlier apical than basal activation. During RVA pacing, the action sequence deviates significantly from the physiologic one and is associated with a considerable depression of LV function<sup>5</sup>, a high incidence of myocardial perfusion defects<sup>10</sup>, regional changes in tissue perfusion<sup>11</sup>, increases in tissue catecholamine activity<sup>12</sup>, disorganization of myofibers and subcellular elements<sup>13</sup>, and variable degrees of cellular alterations ranging from mitochondrial morphologic changes to degenerative fibrosis and fatty deposits<sup>14</sup>.

*Focus is now shifting to identification of the optimal or ideal site for pacing and delivering leads to those locations.*

*Cardiac resynchronization utilizing biventricular (BiV) pacing is currently being widely recommended as a treatment for congestive heart failure in people.*



*Preliminary data from an ongoing study at the University of Florida Veterinary Medical Center show improvement in ventricular synchronization and left ventricular systolic function when paced from either the left ventricle or in a biventricular mode.*

### Where Is the Ideal Pacing Sites?

When considering how to maximize the clinical benefits of pacing therapy for bradyarrhythmias, attention has traditionally focused solely on the features of the device generator. With renewed appreciation for the important role that the site of pacing may play in patient outcome, focus is now shifting to identification of the optimal or ideal site for pacing and delivering leads to those select locations. The fact that RVA pacing causes left ventricular dysfunction was recognized as early as 1925<sup>15</sup>. During both sinus and atrial pacing, the Purkinje system contributes significantly to rapid electrical activation of the ventricles, whereas with ventricular pacing, the impulse is almost exclusively conducted more slowly through myocardium. When Wiggers examined a variety of stimulation sites on the epicardial surface of the dog heart, he found that site of stimulation exerted considerable influence on LV function and postulated that the degree of functional impairment was inversely related to the proximity of the stimulation site to the His-Purkinje system. The question has now arisen, if the RVA is unsuitable for long term ventricular pacing, what then is the alternative?

In an effort to identify the optimal or ideal pacing site that will not worsen cardiac function, alternate sites in the RV have been investigated: the RV outflow tract, RV septum, and the RV free wall. The results of studies evaluating these alternate pacing sites have given conflicting and controversial results<sup>16-18</sup>. His-bundle pacing has been of theoretical interest for many years. The idea of delivering a pacing impulse directly into the cardiac conduction system is attractive because of the possible hemodynamic benefits that could be obtained by a normal activation sequence. However, the small size and anatomic position of the His bundle have made this approach difficult.

Cardiac resynchronization utilizing biventricular (BiV) pacing is currently being widely recommended as a treatment for congestive heart failure in people. The concept being that heart failure has occurred because of dysynchronization within the conduction system and 'resynchronizing' the contraction pattern results in dramatic improvements in cardiac function<sup>18,19</sup>. In this situation, simultaneous or near simultaneous stimulation pacing of the RV and LV is possible transvenously utilizing traditional pacing sites (the RV and RA) and third lead placed within the coronary sinus and into a left lateral coronary vein overlying the left ventricular free wall. Such a pacing strategy has not yet been shown to protect or improve LV performance in patients requiring pacing for bradyarrhythmias and is currently being investigated at the University of Florida, College of Veterinary Medicine. Dogs with naturally occurring third degree or complete heart block in need of pacing therapy are randomly assigned to three treatment groups with differing combination of long term pacing leads: (1) Dual chamber RA-RVA pacing, (2) Dual chamber RA-LVF pacing, and (3) Dual chamber Bi-V pacing. Synchronization is assessed by electrocardiograms and tissue Doppler imaging, and cardiac function is assessed by echocardiographic determination of stroke volume, cardiac output, and ejection fraction. Preliminary data show an improvement in ventricular synchronization and left ventricular systolic function when paced from either the left ventricle or in a biventricular mode as compared to



**Dr. Amara Estrada**  
Service Chief of Cardiology  
University of Florida  
College of Veterinary Medicine

dogs paced from the right ventricle (Figure 5). This study is currently ongoing at the University of Florida, Veterinary Medical Center.

**Figure 5:** Example of a patient with complete heart and a biventricular pacing system.



One lead is within the right atrium. A second lead is in the traditional location, the right ventricular apex. A third lead has been placed into the coronary sinus (from the right atrium) and passed through the left lateral coronary vein into a position overlying the left ventricular free wall. The ECGs to the left show this patient paced in different lead configurations and the difference in the appearance and width of the QRS complexes.

#### References

[http://www.doh.state.fl.us/Environment/medicine/One\\_Health/CardiacPacingReferences.pdf](http://www.doh.state.fl.us/Environment/medicine/One_Health/CardiacPacingReferences.pdf)

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### United States Army Veterinary Command



**A culture of Service  
A people of Integrity  
A standard of Excellence**

**Professionals Serving  
Heroes Everyday**

### The U.S. Army Veterinary Command and the Department of Defense Military Working Dog Veterinary Service Hospital

#### Colonel David S. Rolfe DVM, MS, ACVIM

The U.S. Army Veterinary Command (VETCOM) is composed of approximately 1,400 Soldiers including Commissioned Officers, Warrant Officers, Non-Commissioned Officers, Enlisted Soldiers, and civilians employees who are stationed worldwide. Each day, they carry out a Department of Defense mission, performing food inspection and animal care operations for all the branches of the military: Army, Navy, Air Force, Marine Corps, and Coast Guard, as well as Department of Homeland Security animals. COL David Rolfe, VETCOM Commander says, "Whether ensuring safe food and water or healthy people and animals, we try hard to provide outstanding customer support. We're very proud of our service throughout the DOD."

All of the Commissioned Officers within VETCOM are veterinarians who have graduated from an accredited veterinary school or completed the ECFVG



**A Military Working Dog walking on a treadmill**

*VETCOM personnel have the unique responsibility of taking care of Government Owned Animals (GOAs) which include Military Working Dogs.*



**Department of Defense Military Working Dog Veterinary Service Hospital, Lackland Air Force Base**

*The new hospital demonstrates the benefits of inter-service and inter-agency cooperation.*



**CT scan of a Military Working Dog**

exam. They are primarily responsible for both food inspection and animal medicine. Enlisted Soldiers make up the bulk of the Veterinary Command and are highly trained individuals divided in either the field of food inspection specialists or animal care technicians.

On the food inspection side of the mission, VETCOM personnel are responsible for installation food inspection, which involves all food coming onto every military installation around the world. The Officers also travel to commercial establishments to inspect factories and plants who supply food to the military. As part of the food defense and safety mission, VETCOM maintains its own Food Analysis and Diagnostic Laboratory located at Fort Sam Houston in San Antonio, Texas. The lab's primary mission is to provide food health protection to service members through the microbiological, chemical, and zoonotic testing they are able to perform there. They provide referral and technical consultation services to help integrate laboratory testing into science-based audit and inspection systems.

VETCOM personnel also have the unique responsibility of taking care of Government Owned Animals (GOAs) which include Military Working Dogs used for many jobs including drug and bomb detection, as well as Military Working Horses used for federal ceremonies, Cavalry units, and Caisson Platoons. At a few other military installations, other species of animal are taken care of on a regular basis by VETCOM personnel to include deer, goats, geese, and marine mammals. Some Department of Defense animals who currently receive care from the U.S. Army Veterinary Corps include dogs from the Transportation Security Administration, U.S. Customs and Border Protection, the U.S. Department of Agriculture, and the U.S. Secret Service. The mission for the VETCOM Soldiers is extensive and care to all these animals is thorough.

In order to support the approximately 2,300 Military Working Dogs, as well as the near 1,000 Department of Homeland Security and other Federal Agency dogs, the Army maintains a Department of Defense Military Working Dog Veterinary Service (DODMWDVS) Hospital, located at Lackland Air Force Base, San Antonio, Texas. With the increase of effort against the Global War on Terrorism, the Department of Defense recognized the need to increase the number of working dogs. This meant an upgrade to the working dog hospital at Lackland. In October 2008, a grand opening was performed in honor of the new military veterinary hospital at Lackland. The new 38,000 square foot facility was built and outfitted at a cost of approximately \$15 million provided by the Air Force and Transportation Security Administration (TSA). The hospital boasts the newest 64-slice CT machine, digital radiography, and two large operating rooms with endoscopic surgical capability, a rehabilitation section to include an underwater treadmill, ICU, in-house laboratory, and electrodiagnostics.

The hospital director Colonel Bob Vogelsang comments, "The primary job of the DODMWDVS is to support the dogs at the Department of Defense Military Working Dog School and the TSA National Explosives Detection Canine Team Program at Lackland." He adds, "The previous hospital was originally constructed in 1968 and had become too small for the increase in military dog patient load, veterinary staff, and the advances in technology over time."



**A Military Working Dog taking a break on the underwater treadmill**

*“Everyone benefits, and we’re proud to provide this world-class service to all our canine and human customers.”*



**Colonel David Rolfe**

There is an average daily population of approximately 750 dogs which are provided full veterinary care by the hospital staff. The dog center staff is currently made up of a mixed population of military and civilian employees of over 40 people including 12 veterinarians and 25 technicians. Currently three members of the veterinary staff are Captains involved in an internship program sponsored by the hospital. The intern program is aimed at giving two to three new Army veterinarians per year the opportunity to be immersed in a busy canine medicine environment for 8-10 months prior to heading to their first duty station.

The hospital serves as the worldwide referral center for military dogs and has approximately 20 referrals in the hospital receiving care at any given time. Though the military dog training program is overseen by the Air Force, the Army is the only branch of service which has a Veterinary Corps to provide animal care. The hospital also treats other Federal Agency dogs that require its medical assistance. The dogs are referred from world-wide locations to seek the expertise of the hospital staff for a large variety of specialty diagnostics to include surgery and radiology.

“We are very excited about this new hospital because it exemplifies the benefits of inter-service and inter-agency cooperation,” notes COL Rolfe. “Not only will the new facility allow us to provide the state-of-the-art care these working dogs deserve, it will also allow us to provide better training experiences for all military veterinarians and technicians who pass through the facility. Everyone benefits, and we’re proud to provide this world-class service to all our canine and human customers.”

***Colonel David Rolfe became the Commander of the U.S. Army Veterinary Command in June 2007. He entered the U.S. Army Veterinary Corps in July 1986 after graduating as a Doctor of Veterinary Medicine from Kansas State University. He completed a residency in Small Animal Internal Medicine and received his Master's Degree in Clinical Sciences from Colorado State University in 1994.***



## **BUSHMEAT AND HUMAN HEALTH: SOCIAL IMPACTS OF WILDLIFE HARVESTING IN LIBERIA**

**Richard A. Nisbett, PhD, MSPH and Reginald A. Hoyt**



**African forest elephants**  
Courtesy: Thomas Breuer

The Upper Guinea forest block stretches from Guinea and Sierra Leone in west tropical Africa to Ghana in the east. In Liberia, these forests occur as primary lowland rainforests in the southeast and primary deciduous forests in the northwest. The Upper Guinean hotspot ranks 1<sup>st</sup> in mammalian diversity with over 150 species, 8<sup>th</sup> in plant diversity, contains over 620 avian species with 80 endemics, 125 endemic reptile and amphibians species, and more than 1,000 insect species. Some endemic mammals are: Jentink’s duiker, Zebra duiker, Liberian mongoose, pygmy hippopotamus, forest elephant, western common chimpanzee, and Diana monkey.



*Forest peoples worldwide interact daily with animals, whether wild or domesticated.*



All photos in this article © by Reg Hoyt and Forest Partners International unless otherwise noted.



A Liberian hunter returns home with a Maxwell's duiker and an endangered Diana monkey.

*The bushmeat trade plays a major role in the national, regional, and local economies, provides the majority of Liberia's dietary protein, and serves as an economic and nutritional safety net.*



Map of the Guinean Forests of West Africa. (Source: [CI/CABS](#))

Liberia also has a very high infectious disease burden. The major soil-borne, zoonotic and vector-borne infectious diseases <sup>7</sup> include:

• African tick typhus	• Holoendemic malaria
• Buruli's ulcer	• Monkeypox
• Dengue Fever	• Onchocerciasis
• Dracunculiasis	• Paragonimiasis
• Ebola and Marburg (?) viruses	• Rabies
• Filariasis	• Schistosomiasis
• Intestinal parasites	• Trypanosomiasis
• Lassa Fever	• SIV
• Leishmaniasis	• Yellow Fever
• Leprosy	• Other arboviruses?
• Lice-borne relapsing fever	• Other rodent-borne viruses, e.g., hantaviruses?

Containing about 45% of the remaining, intact Upper Guinea forests, Liberia has experienced a quarter century of civil disorder, beginning with a coup in 1980. From 1989-2003, civil war erupted as gangster warlords sought to control territory in order to appropriate and extract natural resources, including diamonds, gold and timber. Of the pre-war population of about 2.5-3.0 million, it has been estimated that 200,000 people died and perhaps as high as one-third to one-half of the population was either internally or externally displaced <sup>3</sup>. One of the authors (RAN) began working with traditional healers and traditional hunters in 1988. Initiated by RAH and conducted from 1998 to 2006, we undertook longitudinal studies to generate detailed data on bushmeat procurement, impacts on biodiversity and endangered species, as well as the social, economic, and marketing aspects of the bushmeat trade in both rural and urban Liberia. These multidisciplinary teams included experts and college students from forestry, biology, community ecology, anthropology, disease ecology, and epidemiology.

The forest people of Liberia practice subsistence agriculture, with rice and cassava as dietary staples. Annually, there is a pronounced "hungry season" prior to the harvesting of upland rice in September. On a typical one hectare plot, a farmer can get 1-2 rice harvests, and 2-3 cassava harvests after which the land lies fallow for 5-7 years. Forest peoples worldwide interact daily with animals, whether domesticated or wild. There are many social dimensions of hunting and wild meat



Children holding Gambian pouched rats in Sinoe County, Liberia.

*Hunting, butchering and handling of wildlife pose occupational risks for contracting zoonoses.*



Pet lesser spot-nosed guenon in Liberia, West Africa.

*And since forest animals are also prized as pets — primarily non-human primates and Gambian pouched rats — opportunities for cross-species transmissions abound.*

consumption in Liberia: cosmology and mythology, clan and family taboos, economics (household income, crop-pest control, etc.), diet and nutrition. There are negative synergies among dietary deficiencies, malnutrition, and infectious-disease burden. While it has not been possible to undertake rigorous nutritional studies in the conflict-post conflict setting, surrogate markers such as infant mortality rate (IMR), child mortality rate (CMR), and maternal mortality rate (MMR) correlate with malnutrition. Recent rapid assessments <sup>2, 8</sup> have provided these bleak findings: an MMR of 974/100,000; a CMR <5 years of age of ~195/1,000; stunting at 39% and wasting at 7% for those children aged less than five years. The CFSNS survey again confirmed that the most heavily impacted populations, with regard to poor health indicators, occur in areas of high biodiversity and relatively intact high forests in Liberia.

Wasting is associated with protein deficiency. Bushmeat is a ready source of protein for diets that are protein- and calorie- deficient on an annual cycle, and it has been estimated in a 1991 study that up to 75% of Liberia's meat protein comes from bushmeat <sup>1</sup>. In our socio-economic study of 20 communities surrounding Sapo National Park <sup>5</sup>, bushmeat sales constituted 25-50% of household income for a random sample of households per community, far outstripping income derived from farming activities. Occupational risks for contracting zoonoses vary by type of hunting (subsistence vs. commercial, firearm vs. snares and traps), butchering by locale (forest processing, village processing, or market handling), by market type, etc.



Straw-colored fruit bats on sale in a Robertsport, Liberia market stall.

Since forest animals are also prized as pets—primarily non-human primates (NHP) and Gambian pouched rats (*Cricetomys gambianus*)—opportunities for cross-species transmissions abound. In fact, some hunters have taboos based on signs and symptoms they associate with particular species, e.g., monkeypox and the olive colobus (*Procolobus verus*). Based on long-term studies <sup>4, 5</sup> we have estimated that the total large mammal harvest (shot and trapped) in our study area yielded 221,952 animals/year. Of this total, about 68% were antelope species, with only 9% being nonhuman primates. Furthermore, about 23% of these animals were from species protected under Liberia's wildlife laws. Based on this total harvest, the income derived was about US \$470,000/year yet per capita income in

*Managing an ecosystem goes beyond just environmental protection. It revolves around seeking an optimal balance for health and well-being.*



*The future of tropical forests, wildlife, and the people that depend on them are inextricably linked.*



Courtesy CDC/ Dr. Frederick Murphy

Liberia during this time period has been estimated at US \$125-250. In fact, hunters are considered to be among the wealthiest members of their communities.

Using this total harvest estimate, we used a force-of-infection formula to calculate the potential for cross-species transmissions of viruses from NHPs. We considered only those verified or strongly presumed "viroses" extant within in the Upper Guinean forests which are transmitted by direct contact (filovirus e.g., Ebola; polyomavirus e.g., SV-40; orthopoxvirus e.g., Monkeypox; and the retroviruses e.g., SIV, PTLV, SFV). Based on conservative assumptions (e.g., a background rate of 1% seroprevalence in the NHP host population), we estimated that within our catchment restricted to the north and east of Sapo National Park, one person every other year is exposed to a directly-transmitted NHP virus.

The ecohealth approach recognizes that the dynamic, reciprocal links between humans and their biophysical, social, and economic spheres are reflected in the health of the individual. Managing an ecosystem, then, goes beyond environmental protection and actually revolves around seeking an optimal balance for human health and well-being<sup>6</sup>. Beyond the issue of disease emergence, the bushmeat trade plays a major role in the national, regional, and local economies and provides the majority of Liberia's dietary protein, serving as an economic and nutritional safety net. The future of tropical forests, wildlife, and the people that depend on them are inextricably linked.

#### References

[http://www.doh.state.fl.us/Environment/medicine/One\\_Health/BushmeatReferences.pdf](http://www.doh.state.fl.us/Environment/medicine/One_Health/BushmeatReferences.pdf)

**Dr. Richard A. "Ran" Nisbett, is an Assistant Professor in the Department of Global Health (<http://health.usf.edu/publichealth/gh/rnisbett/index.htm>) at the University of South Florida in Tampa FL. Ran began working in Liberia in 1988.**

**Reginald A. Hoyt is President/CEO of Forest Partners International (<http://www.forestpartnersinternational.org/>) and Co-Chair of the Department of Animal Biotechnology & Conservation at Delaware Valley College in Doylestown, PA. Reg began working in Liberia in 1997.**



## Baiting Ebola

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**TheScientist.com**

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Elie Dolgin, PhD

At the Leipzig zoo's Wolfgang Köhler Primate Research Center last summer, a 3-year-old female gorilla named Kibara was going berserk. She had just been given a new type of food, deep-red colored candies with a rich mango scent. Kibara had never smelled mango before, and she couldn't get enough of the aromatic treat. "Kibara was crazy, running from one point to another, cracking open [the candies], and eating them up," recalls Martina Neumann, a behavioral biologist at the Max Planck Institute for Evolutionary Anthropology in Leipzig. "She was just like, 'this is sweet; I love it.'"

*In addition to causing deadly outbreaks in human populations, the Ebola virus has also been responsible for massive die-offs of gorillas and chimpanzees in Africa.*



*Peter Walsh along with Max Planck primatologists and experts from the German vaccine manufacturing company, IDT Biologika have teamed up on a pilot study to deliver oral Ebola vaccines to great apes.*

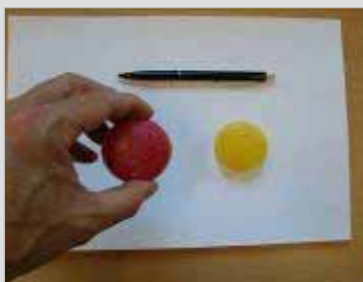


Photo courtesy Peter Walsh

**The puck-shaped, scented baits, contained agar, fructose and eventually, the viral vaccine.**

Kibara was the subject of a pilot study on delivering oral vaccines to great apes. Now that a handful of experimental Ebola vaccines have proven effective in laboratory monkeys, researchers need to find a way of delivering a vaccine to apes in the wild. But the baits used for decades to deliver a rabies vaccine would melt and dissolve in the hot, wet tropical rainforests of Africa. Apes also have nimble hands, meaning they handle baits differently than foxes and raccoons, and their palates lean more to sweet fruits than the rabies baits' fishmeal flavor. A completely new design was needed.

In 2007, Peter Walsh led a group of Max Planck primatologists who teamed up with experts from the German vaccine manufacturing company, IDT Biologika, for a preliminary feasibility study into designing an oral Ebola vaccine. "I know all the science, but I don't know anything about the vaccine development business," says Walsh, a quantitative ecologist who had shown that a single Ebola epidemic killed approximately 5,000 gorillas in a 2,700-km<sup>2</sup> region of central Africa (*Science*, 314:1564, 2006). The design they narrowed in on was a 6-centimeter, puck-shaped lozenge, containing agar, fructose and eventually, they hoped, the viral vaccine. The bait was coated in paraffin wax to withstand the harsh African climate, but what color and scent would best attract the apes? From August 2007 to April 2008, the researchers ran near-monthly trials testing different color-smell combinations with the captive gorillas, chimps, and orangutans at the Leipzig zoo.

The researchers tried three different fruit colors (red, orange, and yellow) with three different scents (banana, fig, and mango). On the first choice trial, however, the 27-year-old silverback gorilla named Gorgo simply ate all four baits he was given. Across all the trials, the color of the bait didn't seem to matter much, but there was a clear preference for mango scent, especially among the chimpanzees. Because they were studying only a limited number of captive animals, though, Adrian Vos, a wildlife biologist with IDT Biologika who was involved with the trials, is quick to note that the trials don't qualify as a scientific food-preference study, and none of the work has been published in any peer-reviewed journals. "We only wanted to see if the animals would accept the baits, and how they would handle them," he says.



**There was a clear preference for mango scent, especially among the chimpanzees.**

Courtesy of IDT Biologika.  
Photo Credit: Andrea Schaezler

Walsh is now planning a trip to Africa this summer to test the baits in the field. First, he plans to investigate bait placement strategies. The best bet, says Vos, is probably placing baits low in the tree canopy to avoid both ground-scrounging competitors like rodents, as well as monkeys and birds higher up in the tree tops.

For now, the baits will just contain sugar, but ultimately Walsh and Vos plan to incorporate a live, attenuated Ebola virus. One concern is "spillage," says Vos: The apes either drop much of the bait on the floor or swallow it whole, so only a



Photo courtesy Peter Walsh

Martina Neumann (left) and two of her colleagues sniff out the baits for themselves.

small amount of virus is usually absorbed in the cheek epithelial cells. Thus, the baits should contain a live virus that can replicate in the blood system and build up a large enough viral titer.

There is another concern: A live virus can revert to a virulent Ebola strain, which might harm other animals that are drawn to the candy-like bait. So Walsh also plans to test hypodermic darts containing freeze-dried vaccine - he calls them biobullets - though finding the apes and getting close enough to vaccinate can be difficult. "The gorillas and the chimpanzees will decide which approach is more suitable," says Vos.

*Dr. Elie Dolgin is an associate editor at The Scientist magazine in Philadelphia.*



## The Path to "One Health": Prevention of Human and Animal Rabies

Peter Costa, MPH, CHES and Carl Williams, DVM, DACVPM

The Alliance for Rabies Control (ARC) was established with the specific goal of uniting the global rabies community, human health and veterinary experts, and international health organizations in order to bring together the world's expertise in rabies control and focus collectively on the objective of reducing human and animal suffering from rabies. Since 2006, ARC has helped educate millions of people about rabies and is currently communicating prevention messages into more than 190 countries through its flagship initiative, the World Rabies Day Campaign (WRD).

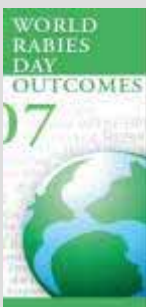


Photo courtesy of  
Tendeka Matatu and  
Suzanne McNabb

### One Health in Action!

The Alliance for Rabies Control funds five community-based organizations to undertake rabies control and education programs

The Alliance for Rabies Control was established with the specific goal of uniting the world's experts in rabies control to reducing human and animal suffering from rabies.



In 2007, funds raised by the Student American Veterinary Medical Association (SAVMA) during WRD were donated to ARC and earmarked for local rabies prevention projects. With a matching donation by Veterinarians without Borders - Canada (VWB) and a supplemental private donation, ARC was able to fund five community-based organizations to undertake rabies control and education programs in regions of great need. These programs, one each in China, Guatemala, Kenya, Peru, and Vietnam, are designed to raise awareness and improve education of the population in high risk rabies areas with the ultimate goal of decreasing the incidence of human and animal rabies. A brief description of each program follows.



### China:

*Educate people in rural areas that rabies can be prevented in people and eliminated in dogs.*

**China:** The goal of this study is to educate the people in rural areas that rabies can be prevented in people and eliminated in dogs. Educational posters will be designed and distributed in a selected area communicating the importance of vaccinating dogs, actions to take if bitten, and provide them with the “SOS” information, i.e., phone number for PEP and phone numbers for dog rabies diagnosis. The effectiveness of the educational posters will be evaluated by conducting a survey before and after poster distribution that measures knowledge of rabies in the population, dog vaccination coverage, and percentage of PEP initiation in humans.



### Guatemala:

*Educate the people, specifically children, about rabies and increase rabies vaccination coverage among dogs.*

**Guatemala:** In rural areas of Guatemala, dogs are part of daily activities, accompanying their owners in agricultural and hunting activities and providing protection as watchdogs. However, in areas where poverty may be such that people can barely feed themselves, dogs are left to themselves to find food, often becoming stray dogs and are not typically vaccinated against rabies. Rabies is a neglected disease in Guatemala and is a disease of the poor, as the cases occur in rural and periurban areas, in largely illiterate indigenous populations. This initiative proposes to work at the community-level and includes educational activities involving professors of primary schools, health agents, volunteers, private veterinarians and government partners. By educating the population, and specifically children, an increase in vaccination coverage among dogs is expected and attendance to health services due to a bite from a dog is expected to decrease.



### Kenya:

*Involve the population in an educational awareness initiative about vaccinations, proper garbage disposal, and appropriate rabies treatment.*

**Kenya:** In Kibera, a community-based rabies awareness exercise will be conducted over an area of 2.5km<sup>2</sup> with a human population estimate of 800,000. A survey of the area reveals a large number of dogs scavenging around an equally large number of meat selling points. This number could by far surpass the 4.5 dog/km<sup>2</sup> density threshold necessary for persistence of rabies. The project will focus on an aggressive educational awareness initiative and involve the population on matters concerning vaccinations, proper garbage disposal, and appropriate rabies treatment. Empowering the community on proper garbage or alternative garbage disposal may provide a more ethical means of controlling dog population rather than adopting traditional methods of dog control.



### Peru:

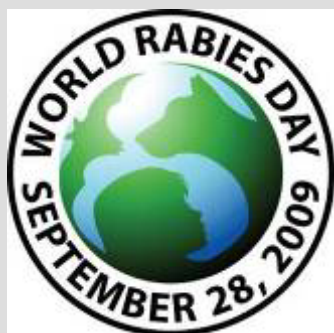
*Engage native communities in the preparation of the educational materials and training activities to raise awareness about bat-borne rabies*

**Peru:** In the Northern region on the Peruvian Amazon jungle, exposure to vampire bat rabies transmitted by the hematophagous bat, *Desmodus rotundus*, is one of the most frequent public health problems affecting the native population. From 1975 to 2004, at least 20 vampire rabies outbreaks in humans have occurred among this population, killing around 110 people. This project will promote participation from the native communities versus the traditional approach where health service officers prescribe the “best approach” for the native populations which results in limited acceptance and low behavioral change. Two native communities will be selected to apply these distinct public health education approaches. Both communities will be surveyed previous to the intervention activities to gather descriptive information on the rabies risk of the community by household and to obtain baseline information on exposures before the interventions. In one native community (Control Community), the traditional approach for public health education will be used. In the other community (Experimental Community), participative techniques will be used to allow



**Vietnam:**

*Educate 2,000 school children about rabies; increase the number of dogs vaccinated by 100% and decrease dog-bite cases by 90%.*



*One Health in Action!*

the school teachers, school children, and their parents to intervene during the rabies preparation of the educational materials and in the organization of the training activities.

**Vietnam:** According to the Vietnam Rabies Control Program, rabies deaths are on the rise in recent years. In 2007, there were 125 deaths nationwide compared with 34 cases in 2003. However, unofficial estimates by the Ministry of Health suggest that the total number of deaths per year could be closer to 500; more than half of which are in children less than 18 years of age. The goal of this project is to reduce the number of people, particularly children, who are bitten by dogs and dying of rabies in Vietnam. The project has three specific objectives: to educate 2,000 school children in three schools in the selected districts; to increase number of dogs vaccinated by 100% and decrease dog-bitten cases by 90%, compared with the previous years; and to increase prevention efforts and resources for rabies control in Vietnam at the local and national levels.

The Alliance for Rabies Control advocates for the health of the total population, human and animal, through a "One Health" approach - starting with rabies - and is looking forward to providing updates about how these programs are progressing and saving lives. Thanks to a continued partnership with SAVMA and VWB-Canada, the Alliance for Rabies Control will again be funding community-based projects with the goal of decreasing the incidence of human and animal rabies in 2010. For more information please visit the ARC website at: [www.rabiescontrol.net](http://www.rabiescontrol.net) or [www.worldrabiesday.org](http://www.worldrabiesday.org).

***Dr. Carl Williams serves as the veterinary outreach coordinator for the Alliance for Rabies Control. Additionally he serves as the North Carolina State Public Health Veterinarian and manages the state rabies prevention and control program, companion animal spay neuter and vector-borne disease programs.***

***Peter Costa is a health communications specialist with a specific interest in community health education. Peter serves as the global communications coordinator for the Alliance for Rabies Control (ARC) and oversees the global communications activities for ARC and its flagship initiative, the World Rabies Day campaign.***



***Brittany King, a third year veterinary student at St. George's University, submitted the following article by Davette St. Louis. It was originally published in the St. Georges's University Gazette.***

### **"One Health, One Medicine" Clinics for Grenadians and Their Pets**

**Davette St. Louis**

Humans and animals can be affected by the very same diseases, and it is essential that medical personnel work together in their fight for wellness, regardless of the species they are treating. The theme of "One Medicine - One health" was firmly etched in the minds of the residents of a St. David's village on Saturday, 10th November, 2007 when for the first time ever, both arms of medicine at the SGU



*One hundred and forty human patients were seen at the health fair.*



*Over sixty dogs and cats, and even a few goats were treated.*



ventured forth together in service to the community. The event, held in Dierre Morne in St. David's, a joint effort of student organizations AMSA and SAAVMA, was highly successful with a great turnout from residents. Students and other SGU personnel were also present in large numbers, giving great support and a commendable show of volunteerism. Residents had very few complaints, stating that they only wished that SGU would soon return and that hopefully an even broader cross-section of health concerns for both humans and animals could be dealt with next time. The Health Fair/Vet Clinic was the brainchild of Brittany King, a third term SGUSVM student.

Oddly, the inspiration came from an irate attendee at one Vet clinic who shared her disapproval of the fact that, at that clinic, pets were being given free health care but there were no arrangements to take care of the health needs of their owners. "I couldn't blame her for feeling that way and actually agreed with her. I decided the next clinic needed to provide health care for people and their pets at the same time," said Brittany. She immediately contacted the president of AMSA, Asad Bandealey, who was equally thrilled by the idea. Together they worked indefatigably to make the event the success it turned out to be.

One hundred and forty patients, including 20 senior citizens at a local nursing home, and 5 home-bound patients were seen at the health fair where several tests, including blood pressure screening, blood glucose screening, eye exam, ear exam, and breast cancer screening, were conducted. IEA, the SGU academic honor society, was in attendance conducting patient education, and the Pediatrics Club conducted health-related activities with children. Women in Medicine (WIM), a group under the AMSA umbrella, conducted 50 breast exams, in addition to educating women on when and how to perform their own monthly breast exams. "For some women, this is their first breast exam, which also may indicate absence of regular Pap smear testing," revealed Stephanie Muriglan, president of WIM. "At these health fairs, WIM has set a goal to bring awareness to Grenadian women about the importance of these clinical measures. Knowledge and control over their reproductive health is an important form of empowerment."

At the Vet Clinic, over 60 dogs and cats were treated. The students showed their versatility and were not fazed when five or six goats were brought along. Although not necessarily physically large, goats, by definition, are not "small animals" due to a difference in the physical makeup of their digestive system. The goats were treated (in a limited way, of course) and the farmer was given advice concerning them, in addition to advice on how to deal with his sty of itchy pigs (not small animals either) who fortunately, were not brought along. The students drew the line after this, denying treatment to a few chickens who wandered in of their own volition. The small animals at the Vet Clinic were given oral dewormer and mange treatments and were vaccinated with a brand new 3-year Continuum DAP-R vaccine from Intervet which would keep the animals protected from Distemper, Rabies, Adenovirus, and Parvovirus for the next three years. The animals' owners also went away with Banfield leashes, collars, and bandanas, in addition to a wealth of information concerning the health of their animals. Several pamphlets concerning pet health, including a list of zoonotic diseases (diseases which can affect both humans and animals) were handed out. The Health Fair/Vet Clinic has already reached even further than is readily observable. In a special Fall promotion, Intervet, the drug





*“Humans and animals can be affected by the very same diseases, and it is essential that medical personnel work together in their fight for wellness regardless of the species they are treating.”*

company from which the vaccines were ordered, matched the order vaccine for vaccine and sent it along to Africa as well, where 200 pets would receive free health care.

The students coped valiantly with temperamental weather, limited space, and long lines. Despite all this, volunteers reaped innumerable benefits from their Health Fair/Vet Clinic experience and had lots of fun despite the hard work. Education was a crucial benefit – many of the students learned a lot more about the illnesses they diagnosed and treated, about vaccinating, about the persons they met, and the Grenadian culture.

Stephanie Muriglan comments, “There were three or four really nice ladies from the church that brought us students an endless supply of delicious passion fruit juice and local cakes and sandwiches. If you remember how hot it was and how hard we worked that day, you know the juice was an absolute lifesaver!” She adds, “There is just so much you can take away from one of these fairs, other than how to run a test for sickle cell anemia, it is a memory that will probably last a lifetime.”



Plans are in place to organize similar clinics at least once a semester from henceforth, and the students really hope that this trend would become a set tradition for SGU. Brittany states, “I want to give something back to the Grenadians and the island while I'm here. There should be more of a big picture right now to life than just getting through vet school.” With benefits to humans and animals within and without Grenada, the event can be deemed a huge success.

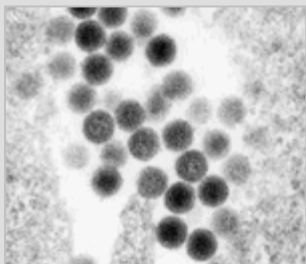
***Davette St. Louis an Assistant Editor for the St. George's University Gazette.***



## **Putting the One Health concept into action: A multi-agency test of a hypothetical introduction of Rift Valley fever into Florida**

**Stasia A. Bembenek Bailey, DVM, MPS**

Rift Valley fever (RVF) is a zoonotic viral disease affecting mainly ruminants and people. It was first reported in the Rift Valley of East Africa, but is now recognized to be an endemic disease affecting most of Sub-Saharan Africa. Since 1970, the virus has occasionally spread northward causing epidemics in Egypt,



RVF virus electron micrograph

Courtesy: C. S. Goldsmith, M. D. Bowen and T. G. Ksiazek

*Rift Valley fever (RVF) is a zoonotic viral disease that is endemic in most of Sub-Saharan Africa.*



Courtesy CDC

**Rift Valley Fever Distribution**

■ Endemic ■ Isolated cases

*It is feared that if RVF is introduced, either accidentally or through bioterrorism, it could have a greater impact than West Nile virus on the animal and human populations of North America.*



Yemen, and Saudi Arabia. RVF is transmitted by several species of mosquito, but human infection is also often associated with the slaughter of infected animals. The disease in most people is characterized by fever and malaise, but a small percentage of patients develop fatal encephalitis and/or generalized hemorrhage. In animals, the disease is particularly severe in lambs and calves, which die of generalized hemorrhage, and pregnant animals commonly abort.

The RVF virus is considered an emerging pathogen and a select agent. It is feared that the virus, if introduced accidentally or through bioterrorism, could have a greater impact than West Nile virus on the animal and human populations of North America. The climate and mosquito species in Florida are particularly ideal for the establishment of RVF, were it to be introduced into the state. With this in mind, Drs. Tom Holt and Greg Christy, with the support of Drs. Carina Blackmore and Danielle Stanek, conceived the idea of a Rift Valley fever training exercise in Florida.

The multi-agency training exercise on an introduction of Rift Valley fever into Florida took place at Florida’s State Emergency Operations Center (SEOC) in Tallahassee, November 18-20, 2008. Participating organizations included:

<b>State:</b>	Florida Department of Agriculture and Consumer Services (FDACS)
	Florida Department of Health (FDOH)
	Florida State Emergency Response Team (SERT)
	Florida Cattlemen’s Association (FCA)
	Florida Division of Emergency Management (FDEM)
	Florida National Guard (FNG)
	Fish and Wildlife Conservation Commission (FWC)
	Florida Veterinary Medical Association (FVMA)
	University of Florida (UF)
<b>Federal:</b>	Department of Homeland Security (DHS)
	Federal Bureau of Investigation (FBI)
	Health and Human Services/Centers of Disease Control (HHS/CDC)
	Southeastern Cooperative Wildlife Disease Study (SCWDS)
	United States Department of Agriculture (USDA)
<b>International:</b>	Institute for Animal Health/Pirbright Laboratory UK (IAH/PL)

The purpose of this exercise was to provide the participants with the opportunity to plan, initiate, and evaluate current response concepts and capabilities in a simulated introduction of this virus. Specific objectives of the exercise included:

1. Give participants an opportunity to learn about the biological complexity of Rift Valley fever,
2. TGive the participants an opportunity to learn about response actions when a bioterrorist event is suspected,
3. Bring together key state regulatory/emergency response agencies that would operate together in a real disease outbreak situation,

*The purpose of this exercise was to provide the participants with the opportunity to plan, initiate, and evaluate current response concepts and capabilities in a simulated introduction of this virus.*



**From left to right:** Tineke Kramer, Paul Gibbs, Stasia Bembenek and Jocelyn Mullins.

*The Florida Rift Valley fever exercise highlighted the importance of Interagency collaboration and a One Health approach in zoonotic disease control.*

4. Have participants explore issues surrounding current diagnostic and response capabilities to Rift Valley fever available in the United States,
5. Have participants explore issues surrounding multi-agency crisis communication efforts involving a vector-borne zoonotic disease incident,
6. Have participants acquire an increased awareness of disease response issues associated with a vector-borne disease.



**Florida Rift Valley Fever Exercise Group Photograph**

The exercise involved approximately 100 professionals for the 3-day exercise. Prior to the exercise, the participants were informed of their designated group (*Incident Command; Focus Group A – Animal Health Issues; Focus Group B – Human Health Issues; Focus Group C – Quarantines, Law Enforcement, Legal Issues; Focus Group D – Entomology, Mosquito Control, Meteorology, Modeling; Focus Group E – Crisis Communication and Public Relations*).

The training exercise centered on a simulated outbreak of RVF designed by Dr. Paul Gibbs, Dr. Stasia Bembenek, and Tineke Kramer of the University of Florida. The scenario, as presented to participants, began with an increase in calf deaths on a ranch in South Florida, followed by mild to severe human cases at various locations. The scenario concluded with a wrap-up connecting the clues of the case and revealing that the introduction of the virus was a bioterrorist event. Potential sequelae of an introduction of RVF to Florida, including the potential for survival of the virus in mosquito populations, were discussed and left open-ended. The need for continued surveillance was emphasized.

**Key positive results of the exercise included:**

- The exercise produced a heightened awareness among participants of the ecological and economic threats of RVF to Florida.
- The exercise educated the participants on issues surrounding both the control of a vector-borne zoonotic disease outbreak and a potential bioterrorist act.
- Inter-group and inter-agency communication improved as the exercise proceeded.

**Key opportunities for improvement:**

- The exercise highlighted the need for better communication between different agencies in a vector-borne zoonotic disease outbreak.



## One Health Newsletter



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- The exercise highlighted the need for agency protocols and policies to address vector-borne zoonotic disease outbreaks.

This exercise simulating the introduction of Rift Valley fever into Florida highlighted the importance of One Health in zoonotic disease control. Interagency collaboration is key to the effective response to a vector-borne zoonotic disease outbreak, and prior education and planning sessions involving multiple agencies are essential for state- and nationwide disaster preparedness. This exercise can be used as a prototype for future multi-agency exercises dealing with a vector-borne disease with a zoonotic component.

*Dr. Stasia A. Bembenek Bailey is a graduate Student in the Department of Infectious Diseases and Pathology College of Veterinary Medicine, University of Florida.*



### FIRST North American Veterinary Conference “One Health” Booth a Success

**Bruce Kaplan, DVM**

The Florida Department of Health-Environmental Health Division and The University of Florida, College of Veterinary Medicine in conjunction with the One Health Initiative website provided “One Health” informational handouts and spokespersons for interested attendees at the first ever “One Health” booth for the North American Veterinary Conference, January 17 – 21, 2009 in Orlando, Florida. Spokespersons for the FL DOH included Drs. Carina Blackmore, Lisa Conti and Mary Echols; Drs. Tara Anderson and Paul Gibbs represented the UF College of Veterinary Medicine; and Dr. Bruce Kaplan spoke for the Kahn-Kaplan-Monath One Health team that manages the One Health Initiative website <http://www.onehealthinitiative.com>.

Materials distributed and representatives present discussed how the One Health Concept is a global strategy for expanding interdisciplinary collaborations and communications in all aspects of health and health care for humans and animals. Several thousand veterinarians, mostly private practitioners from all over the United States and other countries, had the opportunity of being exposed to how the synergism achieved using One Health principles will advance health care for the 21<sup>st</sup> century thereby protecting and saving millions of lives in our present and future generations.

The North American Veterinary Conference graciously provided the booth free of charge and also provided five free courtesy badges for admission to the conference programs. All participants extend their sincere appreciation.

*Dr. Bruce Kaplan is a retired veterinarian, who formerly worked as a CDC Epidemic Intelligence officer, staff officer and regional public affairs specialist for USDA-FSIS and has been a columnist writer/editor. Dr. Kaplan promotes “One Health” collaboratively with Laura H. Kahn, MD, MPH, MPP and Thomas P. Monath, MD.*





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## Recent One Health Publications:

- **'One Health - One Medicine': linking human, animal and environmental health [A One Health Monograph]**  
Veterinaria Italiana - Volume 45 (1) / January - March 2009  
[http://www.izs.it/vet\\_italiana/2009/45\\_1/45\\_1.htm](http://www.izs.it/vet_italiana/2009/45_1/45_1.htm)
- **The Threat of Emerging Ocean Diseases**  
Bulletin of the Atomic Scientists, Feb 18, 2009 - L.H. Kahn  
<http://www.thebulletin.org/web-edition/columnists/laura-h-kahn/the-threat-of-emerging-ocean-diseases>

For other One Health publications visit the One Health Initiative website.



<http://www.onehealthinitiative.com/publications.php>

## Coming Events:

### The James Steele Conference on Diseases in Nature Transmissible to Man (DIN)

Fort Worth, Texas

June 2- 5, 2009, Hilton Fort Worth

<http://diseasesinnature.googlepages.com/din2009>

### Society for Tropical Veterinary Medicine 10<sup>th</sup> Biennial Conference

Lubeck, Germany

June 29 – July 3, 2009

*One Health, One Medicine: Building Bridges to  
Face the Challenge of Emerging and Zoonotic Diseases*

<http://www.stvmgermany.com>

*The One Health Newsletter is interested in publishing articles from a variety of view points and perspectives and any opinions and statements made in the Newsletter articles belong to the author(s), not the Editor, Editorial Board or Newsletter Contributors.*

