One Health Newsletter

A quarterly newsletter highlighting the interconnectedness of animal and human health

Summer 2010 Volume 3 Issue 3

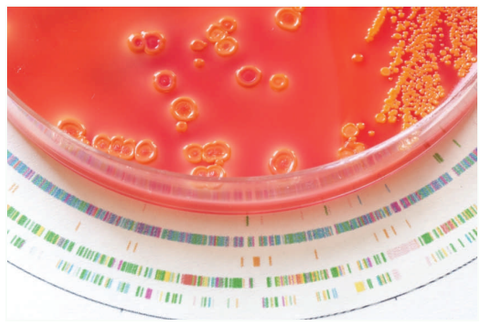
This newsletter is dedicated to enhancing the integration of animal, human, and environmental health for the benefit of all by demonstrating One Health in practice.

An ecological epidemiology approach is necessary to determine the transmission dynamics of antimicrobial resistant zoonotic bacteria in our ecosystem.

Anna Catharina Berge, DVM, MPVM, PhD and Jeroen Dewulf, DVM, MSc, PhD, Dipl. ECVPH, Dipl. ECPHM,

The complexity of antimicrobial resistance

The health risks associated with increasingly antimicrobial resistant zoonotic bacteria for animals and humans are widely acknowledged and of serious concern.[1] Antimicrobial resistance complicates antimicrobial treatments for bacterial disease, and may involve increased duration of disease and treatment period and mortality.[2-4] Factors governing emergence and persistence of antimicrobial resistance in animal production are multi-factorial and complex.[5;6] It is well known that the selection pressure of antimicrobial use increases the multi-resistance of bacteria. In the past the dominant hypothesis was that bacteria carrying antimicrobial resistance genes entailed a fitness cost and hence in the absence of antimicrobial selection pressure the resistance genes would disappear. Yet, more and more field and laboratory studies suggests that bacterial populations seem to be able to successfully retain antimicrobial resistance genes through adaptive mutations and acquisition of other fitness enhancing genes, co-selected by linked genes conferring traits that optimize survival in different environments and therefore do not disappear in the absence of antimicrobial selection pressure.[7-10]



The magnitude of the risk of antimicrobial resistant zoonotic bacteria has been poorly quantified and the thorough understanding of the transmission dynamics of antimicrobial resistance between animal production, environment and the human population through zoonotic bacteria are lacking. Some qualitative and quantitative microbial risk assessments models have been created to assess the risk of antimicrobial use in animal production on the likelihood that human health will be seriously threatened by antimicrobial resistance.[11] However, these models remain controversial as they do not include any potential environmental exposure and are therefore likely to, at least partially, misrepresent true risk. Furthermore, most models focus on a single antimicrobial, and do not address multiple antimicrobial resistance factors. Farm to fork microbial risk assessments are rare, many times due to lack of information at the farm level.[12] Truthful transmission dynamics models need to incorporate all exposure pathways, niches and flows in order to correctly qualify and quantify risks associated with antimicrobial resistance in animal production.[13;14] Studies assessing the hazards of antimicrobial resistance furthermore need to incorporate the potentials for co-selection, genetic linkage and exchange of

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
- Kahn/Kaplan/Monath/ Woodall One Health Team

http://www.onehealthinitiative.com.

Subscribe

OH@doh.state.fl.us

Submit articles, comments to editor

OneHealthEditor@doh.state.fl.us

Editor:

Mary Echols, DVM, MPH

Palm Beach County Health Depart-

In This Issue

Articles:

Coming Events:

Recent One Health Publications:

resistance genes in bacterial populations. The commensal bacterial population can act as a resistance pool from which pathogenic bacteria can obtain resistance genes through processes such as plasmid or transposon transfers.

The *Salmonella* example

The United States Centers for Disease Control and Prevention estimates that only 1 in 38 cases of so-called food-borne disease can be traced back to the source.[15] Difficulties determining an exposure pathway for zoonotic agents that are mainly considered foodborne include detection and reporting bias. The source of human salmonellosis is more likely to be traced back to a source that is not commonly consumed by the general population, such as raw dairy products or uncooked eggs. The salmonellosis cases that are due to other transmission pathways, such as water, soil, fomites and pets, are often more difficult to identify. Therefore, the important question that we must pose is: Are the identified and reported exposure pathways representative of the non-traceable exposure pathways? What proportion of human salmonellosis cases are not caused directly by contaminated food?

In animal populations, "community" prevalence of multi-resistant *Salmonella* and the carrier and non-clinical shedding states have been well described and modelled.[16-18] In contrast, neither the community prevalence nor carriage rate of *Salmonella* in the human population have been well described in the published literature.[15] The under-reporting of human clinical salmonellosis is well known and it is believed that in the US for every reported case observed in Food-Net there are 38.6 additional clinical cases in the community.[15] The number of non-clinical shedders needs to be further determined. Therefore, even less information is available about carriage of resistant Salmonella. Risk attribution models are valuable in determining potential source of zoonotic agents[19], but they are not sufficient to determine exposure pathway.

Human salmonellosis outbreaks have been linked to the use of water contaminated with human feces or animal manure.[20] An increasing number of these *Salmonella*-associated epidemics involve multiple-antibiotic resistant serovars.[20] High levels of multi-resistant *Salmonella* were recovered from municipal wastewater in two cities in California. Testing of eleven 24 hour composite waste water samples revealed multi-resistant *Salmonella* in every single 1 ml of sample tested. The levels of resistant *Salmonella* found in the wastewater were not reflected by the reported number of human clinical cases and indicate that there may be high levels of sub-clinical shedding and unreported antimicrobial resistant *Salmonella* in humans. A Finnish study reported high recovery of

Non-food related actors may indicate that environmental exposure patterns are more important than generally reported.

To prevent the transmission of antimicrobial resistant bacteria to humans requires identifying measures to control contamination of the farm environment and the associated ecosystem.

Fruit bat or "flying fox"

Salmonella from influent water into four conventional wastewater treatment plants.[21] Sub-clinical human shedding may therefore be common even in countries where the animal production population is considered *Salmonella* free.

Studies in Michigan indicated a link between child clinical salmonellosis and day-care centers, cats and reptiles.[22] The median duration of shedding after a clinical case has been estimated to be 5 weeks[23], but little is known about sub-clinical intermittent shedding. Human to human exposure has in most cases been considered of little importance, but it may play a significant role in sub-clinical infections. Contact with birds and reptiles were shown to be risk factors for *Salmonella enteritidis* infections.[24] These non-food related factors mentioned may indicate that environmental exposure patterns have a higher importance then generally reported.

Our task at hand

The *Salmonella* antimicrobial resistance studies performed in animal and human populations and the environment indicate that we have good knowledge of the multiple transmission pathways of antimicrobial resistant zoonotic bacteria. These transmission pathways need to be placed in relation to each other in an appropriate qualititative or quantitative model. The European Food Safety Agency has stated that risk assessment for a specific food-bacterium combination needs to be modified to take into account the following factors; foods originating from food animals, fish, fresh produce, and water as a vehicle for the transmission of antimicrobial resistant bacteria and related genes.[25] With multi-speciality teams and collaborative efforts combined with the strength of modern computers and programmers we now have the ability to start tackling the ecosystem as is. This approach will assist in understanding transmission and risk and in identifying measures to control contamination of the farm environment and associated ecosystem to prevent transmission of antimicrobial resistant bacteria to humans.

References: http://www.doh.state.fl.us/Environment/medicine/One_Health/Ecologicalepi_References.pdf

Dr Catharina Berge and Dr Jeroen Dewulf are professors in the Veterinary Epidemiology Unit, Department of Reproduction, Obstetrics and Herd Health, at the Faculty of Veterinary Medicine, Ghent University, Belgium.
E-mail : anna.berge@ugent.be

Hendra virus

Hume Field, BVSc, MSc, PhD, MACVS

Hendra virus was first described in September 1994, in a novel disease outbreak in horses in Australia. Twenty horses and two humans were infected on that occasion, resulting in the death of 13 horses and one human. A further thirteen incidents (some single-horse events, some multiple-horse events) have been identified to date, resulting in more than 40 confirmed equine cases and seven human cases (four of them fatal).

Fruit bats of the genus *Pteropus* (colloquially known as flying foxes) are the natural host of the virus.

The most recent incident was confirmed on 20 May 2010, when Biosecurity Queensland confirmed a positive Hendra virus PCR result for a horse on a property in Tewantin, in south-east Queensland, Australia. The horse was humanely euthanized after a rapid clinical progression. A second (in-contact) horse on the property was clinically well and negative for Hendra virus in the first round of testing. The second horse will remain under quarantine until samples collected a minimum of two incubation periods after the last exposure opportunity are negative to all tests.

Animal health (Biosecurity Queensland) and public health (Queensland Health) agencies are responding jointly to the incident, and will continue to work with the horse owners, the attending veterinarian and local community.

Culling bats is not the solution to the Hendra virus problem.

The Biosecurity Queensland *Emerging Diseases Research Group,* led by veterinary epidemiologist Dr. Hume Field, is using infra-red cameras to record nocturnal interactions and behaviour in horses, bats and other nocturnal wildlife to better understand how Hendra virus is transmitted to horses. The group is also collecting pooled urine samples from fruit bat colonies in the vicinity as part of ongoing investigations into Hendra virus infection dynamics in bats.

There have been calls from individuals and groups in the community for culling of bats. The Biosecurity Queensland perspective is that culling is scientifically flawed and not the answer to the Hendra virus problem. Fruit bats are an important part of the natural system, promoting biodiversity and supporting the timber industry and nature-based recreation and tourism. Beyond this, it's simply not feasible to cull bats – they are nomadic animals whose movements are driven by food availability – if you cull one location, animals will move in from another location to utilize the food resources. Indeed, culling is likely to be counter-productive and exacerbate virus excretion, firstly by further stressing bat populations, and secondly, the resultant 'sink' effect will result in increased population flux. Most importantly, culling is just not necessary; there are effective measures that people can take to mitigate the risks of infection transmission from bats to horses, and from horses to humans.

There are effective measures to mitigate the risks of infection transmission from bats to horses, and from horses to humans.

The website www.biosecurity.qld.gov.au has up to date information on Hendra virus, including the latest version of the *Guidelines for veterinarians handling potential Hendra virus infection in horses.*

Dr. Hume Field is Principal Veterinary Epidemiologist (Emerging Diseases), Biosecurity Queensland .

Malaria risk in Haiti after the January 2010 earthquake

Elizabeth Radke, MPH

Poor sanitary conditions following the catastrophic earthquake in Haiti on January 12, 2010 have increased the risk of disease for Haitian residents, relief workers, and

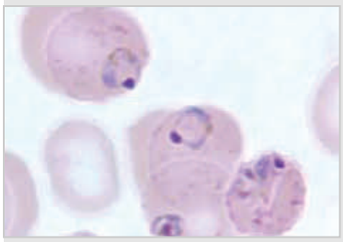
Poor sanitary conditions following the catastrophic earthquake in Haiti have increased the risk of disease for Haitian residents, relief workers, and travelers.

Diseases of particular concern include:

- ***malaria***
- ***dengue fever***
- ***leptospirosis***
- ***measles***
- ***tetanus***
- ***meningococcal disease***
- ***tuberculosis***
- ***rabies***
- ***typhoid and other enterics***

travelers. Because of Florida's geographic proximity to Haiti, large numbers of refugees and returning United States travelers entered the state in the aftermath of the earthquake. Rapid diagnosis of reportable disease conditions in these individuals was important for the patients' health and to prevent further transmission within Florida and the U.S. Diseases of particular concern included malaria, dengue fever, leptospirosis, measles, tetanus, meningococcal disease, tuberculosis, rabies, typhoid, and other enterics.

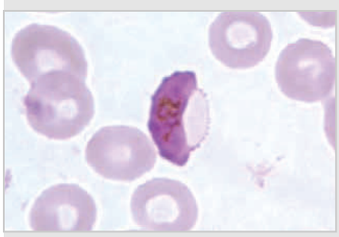
Cases of disease listed as notifiable in the state of Florida are reported to the local county health department (CHD) by the health care provider. Under normal circumstances, only information from cases involving Florida residents are captured in the state surveillance data system, Merlin. Following the earthquake in Haiti, however, CHD staff were asked to record all cases of reportable diseases in Merlin, regardless of residency status. Information from any person who had acquired a reportable disease while in Haiti during or following the earthquake was entered into the system.



Ring-form trophozoites of *P. falciparum* in a thin blood smear Courtesy CDC

Malaria (Plasmodium falciparum only) was the most common disease reported in individuals entering Florida from Haiti following the earthquake.

As of March 30, 2010, malaria (*Plasmodium falciparum* only) was the most common disease reported in individuals entering Florida from Haiti following the earthquake, accounting for 27 of the 64 cases reported (42%). Infections were identified in Haitian residents (12/27), travelers (6/27), relief workers (5/27) and four individuals with other reasons for being in Haiti. Ages ranged from 3 to 74, with a median age of 39 years. All of the Haitian residents and the majority of the non-residents reported not taking antimalaria chemoprophylaxis; however three individuals, two relief workers and one traveler, did report using prophylaxis. Eleven individuals were in need of acute medical care upon arrival in Florida, one for trauma or injury and ten for suspected infectious disease, including two relief workers and one traveler. Cases were primarily reported by counties with large metropolitan areas, likely due to the presence of international airports in those counties.



Gametocyte of *P. falciparum* in a thin blood smear
Courtesy CDC

Even before the earthquake, Haiti was a primary source of imported malaria in Florida. In 2009, 96 cases of imported malaria in Florida residents were reported with 41 (43%) acquired in Haiti. Immigrants returning to Haiti to visit friends and relatives constitute the highest risk group. This is likely due to them not seeking antimalarial chemoprophylaxis prior to travel and staying in environments with less protection from mosquitoes than typical travelers. With current conditions facilitating mosquito breeding and poor housing conditions, all individuals in Haiti, including those outside the normal risk groups, are at increased risk of infection.

The primary transmission peaks in Haiti usually occur during the rainy season months between November and January and May through July; sixty-three percent of Florida cases occurred during these periods in 2009. This indicates that we are currently

in a period of possible high malaria transmission. The Centers for Disease Control and Prevention (CDC) recommends that anyone traveling to Haiti should receive antimalarial chemoprophylaxis and that individuals entering the U.S. from Haiti with fever, chills, and headache should be tested for malaria immediately. Their complete recommendations on prevention and treatment of malaria from Haiti can be found at: http://www.cdc.gov/malaria/resources/pdf/new_info/2010/Malaria%201-pager_Mar4v5_508.pdf

Malaria poses a unique risk for local transmission as infected individuals are able to infect mosquitoes for weeks after infection.

Malaria poses a unique risk for local transmission as infected individuals are able to infect mosquitoes for weeks after infection. *Anopheles* species mosquitoes capable of transmitting the disease, in particular *Anopheles quadrimaculatus,* are widespread in Florida and once infected could result in autochthonous transmission leading to an outbreak. Preventing an outbreak requires prompt diagnosis and reporting by physicians as well as quick action by mosquito control districts once notified of a case.

Anopheles quadrimaculatus
Courtesy CDC

In addition to malaria, a number of other reportable disease cases associated with the Haiti earthquake have been documented in Florida. These include lead poisoning (12), giardia (9), dengue fever (4), cryptosporidiosis (2), hepatitis A (2), shigellosis (2), tetanus (2), possible exposure to rabies (2), salmonellosis (1), and haemophilus influenzae (1). Epidemiologic investigations were performed by CHD personnel for all of these cases and appropriate disease control measures were implemented if necessary. Many individuals arriving in Florida from Haiti have not remained in the state but have traveled on to other locations in the U.S.; therefore other states could face the same disease control concerns. For more information on disease prevention in individuals entering the U.S. from Haiti, please see: http://wwwnc.cdc.gov/travel/content/haiti-earthquake-travel.aspx.

Preventing an outbreak requires prompt diagnosis and reporting by physicians as well as quick action by mosquito control districts once notified of a case.

References:

Fulford, M and Keystone J. Health risks associated with visiting friends and relatives in developing countries. Current Infectious Disease Reports. 2005, 7:48-53.

Malaria: Haiti Pre-decision Brief for Public Health Action. Centers for Disease Control and Prevention. http://emergency.cdc.gov/disasters/earthquakes/haiti/malaria_pre-decision_brief.asp

Elizabeth Radke is Arbovirus Surveillance Coordinator for the Florida Department of Health's Bureau of Environmental Public Health Medicine.

Biomedical Informatics: Bridging the Gap between Science and Medicine

Jonathan Lustgarten, M.S., Ph.D.

The amount of information that scientists, medical professionals, and public health specialists have to process is increasing at an exponential rate. Technologies such as genomic sequencing, shot-gun proteomics, genomic tests, bio-surveillance, and electronic medical records have lead to the need for people who specialize in information

Modern technologies have led to the need for people who specialize in information processing and modeling.

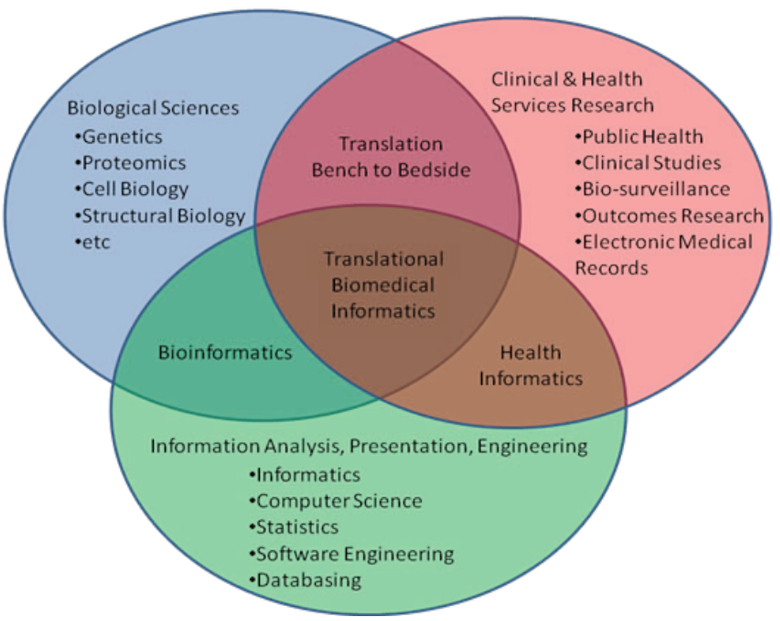
The vast amount of information that scientists, medical professionals, and public health specialists have to process is increasing at an exponential rate.

The Biomedical Informatics field trains scientists, physicians, public health specialists to analyze data that impacts medicine and public health

processing and modeling that allows compression and information extraction from all these technologies while understanding the domain in which they are operating. The Biomedical Informatics field trains scientists, physicians, public health specialists, as well as any person interested in techniques for processing, modeling, and ultimately translating science within the biomedical sphere. For those who are learning about Biomedical Informatics for the first time, the American Medical Informatics Association defines it as (see here for the full definition):

> *An interdisciplinary science that combines health sciences such as human and veterinary medicine, dentistry, nursing, pharmacy, and allied health with computer science, management, and decision science, biostatistics, engineering and information technology. It solves problems in health care delivery, pharmaceutical, biological, biomedical, and health science research, health education and clinical/medical decision making. It is essential in all aspects of health care and biomedicine.*

This wide definition helps explain why the National Institutes of Health have begun to require informatics to be included in some grant applications. It also represents a



field that has spawned a whole host of biotechnologies in the effort to bring bench science into practice. Below is a pictorial representation of the landscape of Biomedical Informatics.

Biomedical researchers including physicians and public health scientists routinely utilize informatics to analyze data that impacts medicine and public health [1-5]. (This small list of references specifically focuses on informatics topics). There are also many studies that have been published in Nature and Science [6-8] and other publications that utilized informatics as a major tool to test their hypothesis. I experienced this first hand during my PhD studies working with excellent researchers at the University of Pittsburgh, School of Medicine in translational research. Upon acceptance into the University of Pennsylvania School of Veterinary Medicine, I saw the opportunity to learn veterinary medicine and apply my training to this discipline. This combination promises interesting, new frontier research avenues since many diseases that affect humans also affect animals and have similar etiologies.

Biomedical Informatics combines health sciences, computer science, management, biostatistics and engineering.

After introduction to the One Health Initiative, I saw the potential for those trained in biomedical informatics as well as the medical sciences to collaborate as the goals of the OHI and the field of Biomedical Informatics overlap. I am personally excited for the opportunity especially as I complete my veterinary degree to apply biomedical informatics to the goals and problems that confront initiatives like the OHI. There are many resources on the web including AMIA that explain biomedical informatics and I encourage researchers interested in bridging the gaps to investigate these methodologies

References:

1. Dudley, J. and A.J. Butte, *Enabling integrative genomic analysis of high-impact human diseases through text mining.* Pac Symp Biocomput, 2008: p. 580-91.
2. Liu, Y.I., P.H. Wise, and A.J. Butte, *The "etiome": identification and clustering of human disease etiological factors.* BMC Bioinformatics, 2009. **10 Suppl 2**: p. S14.
3. Butte, A.J., *Translational bioinformatics: coming of age.* J Am Med Inform Assoc, 2008. **15**(6): p. 709-14.
4. Visweswaran, S. and G.F. Cooper, *Patient-specific models for predicting the outcomes of patients with community acquired pneumonia*, in *American Medical Informatics Association Annual Symposium*. 2005: Washington, DC. p. 759-763.
5. Mollura, D.J., et al., *Bridging radiology and public health: the emerging field of radiologic public health informatics.* J Am Coll Radiol, 2008. **5**(3): p. 174-81.
6. Rifai, N., M. Gillette, and S. Carr, *Protein biomarker discovery and validation: the long and uncertain path to clinical utility.* Nature Biotechnology, 2006. **24**(8): p. 971-83.
7. Chang, H.Y., et al., *Robustness, scalability, and integration of a wound-response gene expression signature in predicting breast cancer survival.* Proceedings of the National Academy of Science U.S.A., 2005. **102**(10): p. 3738-3743.
8. Strausberg, R.L. and S.L. Schreiber, *From knowing to controlling: a path from genomics to drugs using small molecule probes.* Science, 2003. **300**(5617): p. 294-5.

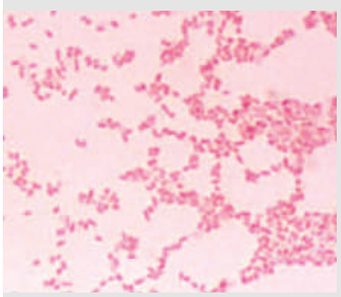
It is essential in all aspects of health care and medicine.

Dr. Jonathan Lustgarten is a VMD candidate at the University of Pennsylvania's School of Veterinary Medicine. JONL@vet.upenn.edu

Human brucellosis remains the most common zoonotic disease globally.

Human Brucellosis in Florida

Danielle Stanek, DVM and Philip A. Lee, MSc FIBMS



Brucella melitensis
Courtesy CDC

The low incidence in the United States can be attributed to the success of the State-Federal Brucellosis Eradication Program Established to control B. abortus in domestic cattle.

Background

Human brucellosis remains the most common zoonotic disease globally with more than 500,000 new cases reported annually. Despite the high number of cases worldwide there are only 100 to 200 cases reported annually in the United States. This low incidence, once as high as 6,000 cases in 1947, can be attributed to the success of the State-Federal Brucellosis Eradication Program established in 1934 to control or eradicate *B. abortus* in domestic cattle herds.

The disease primarily affects fertility in its animal reservoirs, and infected animals generally appear healthy. At least four species of this gram-negative coccobacillus have been associated with human illness: *Brucella melitensis* (goats, sheep), *B. suis* biovars I and III (pigs), *B. abortus* (cattle, bison, elk) and less commonly, *B. canis* (dogs, coyotes). *Brucella melitensis* has been eradicated from goats and sheep in the US, although occasional re-introductions occur from Mexico into south Texas. *Brucella abortus* is considered eradicated from cattle in most states including Florida, however infected elk and bison continue to act as reservoirs for cattle in the Yellowstone National Park area in the western US. *Brucella suis* is endemic in Florida and many other states with feral hogs. *Brucella canis* also occurs sporadically in dogs throughout the US and particularly in the

southeastern US, but is considered less pathogenic for people.

Infected elk and bison continue to act as reservoirs for cattle in the Yellowstone National Park area

The organism is shed in high concentration in the reproductive fluids of infected animals and is also present in animal tissues, milk, blood and urine. Worldwide, transmission to humans primarily occurs through ingestion of unpasteurized milk and dairy products in developing countries that lack uniform disease control programs in domestic livestock. In Florida, exposure occurs primarily through contact with cuts or mucous membranes with infected tissues, blood and other fluids from feral hogs. Accidental percutaneous inoculation with modified live animal vaccine has caused infection in veterinarians.

Aerosol transmission is also possible when the organism is present in high concentrations such as in laboratory settings. It is estimated that inhalation of only 10-100 organisms can cause disease in humans. Because of the low infectious dose, pathogenicity to humans, and potential for aerosol transmission, *B. melitensis*, *B. abortus* and *B. suis* have all been identified as potential bioterrorist weapons and are listed as CDC Select Agents. Additionally, brucellosis is a nationally notifiable disease. Under the Florida Administrative Code 64D-3 all cases of suspect and confirmed brucellosis should be reported to the Department of Health immediately.

The incubation period for brucellosis in humans ranges from approximately 1-2 weeks to six months, with clinical disease developing within two months of exposure in most cases. However, insidious flu-like symptoms that appear to resolve may be overlooked leading to chronic, localized infections. Symptoms in people include intermittent

Worldwide, transmission to humans primarily occurs through ingestion of unpasteurized milk and dairy products.

Reported cases of brucellosis (N = 131) --- United States, 2007

* Actual totals for states with >5 cases are shown in parentheses.

SOURCE: CDC. Summary of notifiable diseases---United States, 2007. MMWR 2009;56(53).

or continuous fever, headache, weakness, profuse sweating especially at night, chills, arthralgia, myalgia, depression, and weight loss. Chronic infection can lead to localized abscesses or focal infections of organs, spine, or joints. Case fatality is 2% or less and is usually associated with endocarditis and other cardiovascular involvement. Appropriate

antimicrobial treatment is critical to prevent chronic infection and relapses (>20% relapse rate in Florida).

Occupational exposures have included laboratory workers and meat packers.

Exposure source for the majority of recent cases in Florida was contact with B. suis infected feral swine, primarily through hunting or handling uncooked meat.

Courtesy of USDA-APHIS-WS National Wildlife Disease Program

B. suis is endemic in feral hogs in Florida and other parts of the US, and will continue to be a source of infection for hunters

Florida

From 1930-1975 there were 936 cases of human brucellosis reported to Florida Department of Health (DOH), with over half those cases occurring from 1940-1949. The number of human cases dropped dramatically following congressional funding in 1954 to focus the cattle brucellosis control program on eradication of *B. abortus* rather than control and eradication. Within a few years, a Florida human brucellosis epidemiology study of cases reported between 1963 to 1975 identified only 61 cases, averaging just under 5 cases per year. Exposure type in 61% of cases was occupational (veterinarian, livestock worker, meat packer), 13% of cases were associated with hunting pigs and no cases were associated with travelers or immigrants.

Due to the highly effective USDA program, *Brucella abortus* was declared eradicated from Florida cattle in 2001, yet in the past decade (2000-2009) an average of 8 cases of human brucellosis were reported annually. Exposure source for 70-80% of recent cases was contact with *B. suis* infected feral swine, primarily through hunting or handling uncooked meat. Occupational risk is much lower (<3%) although infections have occurred in taxidermists as well as veterinary staff working with backyard pigs. At least three cases in other states were linked to Florida, including two individuals who traveled to Florida to hunt feral pigs, and one laboratory acquired infection associated with a blood cultures from a Florida case. The remaining 20-30% of human cases were imported (exposure outside FL or the US) and associated with ingestion of unpasteurized milk, soft cheeses or other raw dairy products in immigrants from or travelers to developing countries. These exposures resulted in infections with *B. melitensis* or less commonly, *B. abortus*. One less typical case was suspected to be linked to a blood transfusion administered outside the US. Most Florida cases acquired outside the US are associated with Mexico (>60% in the past 10 years), but cases have also been associated with the Middle East and South America, and brucellosis is reported to be a growing problem in eastern Europe and Asia. As cases identified in Florida involving non-residents are not included in state tallies, these figures likely under-represent the true number of imported cases seen in Florida hospitals.

Although rare in the US, *B. suis* is endemic in feral hogs in Florida and other parts of the US, and will continue to be a source of infection for hunters and others in contact with these animals. Immigrants and travelers to developing countries such as Mexico will continue to be exposed to *B. melitensis* and *B. abortus* through ingestion of unpasteurized milk products. Laboratory workers handling cultures from these patients should consider this risk while developing laboratory safety policies.

References

Bigler WJ, Hoff GL, Hemmert WH, et. al. Trends of brucellosis in Florida. Am J Epi. 1977;105 (3):245-51.

CDC. *Brucella suis* infection associated with feral swine hunting---three states, 2007—2008. MMWR. 2009;58(22):618-21.

Olsen S, Tatum F. Bovine brucellosis. Vet Clin Food Anim. 2010;26:15-27.

FL DOH Brucella web page: http://myfloridaeh.com/medicine/arboviral/Zoonoses/Zoonotic-brucellosis.html

Dr. Danielle Stanek is Medical Epidemiologist with the Zoonotic and Vector-borne Disease Program at the Florida Department of Health.

Philip A. Lee is the Biological Defense Coordinator for the Bureau of Laboratories, Jacksonville at the Florida Department of Health

We envision One Health education that helps students learn how, when, and who to collaborate with to develop and apply interdisciplinary solutions to global health problems.

Integrating a One Health approach in education to address global health and sustainability challenges

Meredith A Barrett, Timothy A Bouley, Aaron H Stoertz, and Rosemary W Stoertz

***Frontiers in Ecology and the Environment* 2010; doi:10.1890/090159**
Link to abstract: http://www.esajournals.org/doi/abs/10.1890/090159

Neither physicians nor veterinarians receive basic training in environmental science.

Article Summary:

Global health challenges such as emerging zoonotic diseases highlight the need for a One Health approach, which recognizes the connections between animal health, environmental health, and human health. This approach is widely acknowledged by professional and international health organizations and could be used to improve health and conservation policies, improve research, and avoid costly disease outbreaks. Yet graduate training programs often lack interdisciplinary student opportunities. This results from the focus of traditional curricula on reaction rather than prevention, and the anthropocentrism of medicine and medical training. Presently, One Health training is largely reliant on individuals completing multiple degree programs. This model not only shortens the productive lifespan of those individuals due to more years spent in training, but also uses tremendous educational resources on individual students and maintains disciplinary barriers. Instead, we envision One Health education that helps students learn how, when, and who to collaborate with to appropriately develop and apply interdisciplinary solutions to global health problems.

As a group of graduate students from ecology, public health, and human and veterinary medicine, we propose several possibilities for integrating One Health into current curricula and for supplementing educational programs with opportunities for interdisciplinary collaboration. We also highlight potential hotspots of One Health education: regions where medical, veterinary, public health and environmental academic programs are concentrated, creating an ideal environment for training the next generation of One Health professionals.

Currently, less than 3% of US veterinary training is in public health, and less than 2% of US veterinarians consider themselves public health professionals. Human medical training maintains a correspondingly anthropocentric position. Neither discipline receives basic training in environmental science, despite nearly a quarter of global deaths being attributable to environmental factors. One possible solution is the integration of common coursework across these and other relevant disciplines. Medical and veterinary students, for example, could hold conjoint courses in bio-security and infectious disease prevention. Web-based education and distance learning technology could make this feasible for

The University of Minnesota's Public Health Institute, the Envirovet program are good applications of the interdisciplinary One Health Approach.

schools that do not house both veterinary and medical colleges.

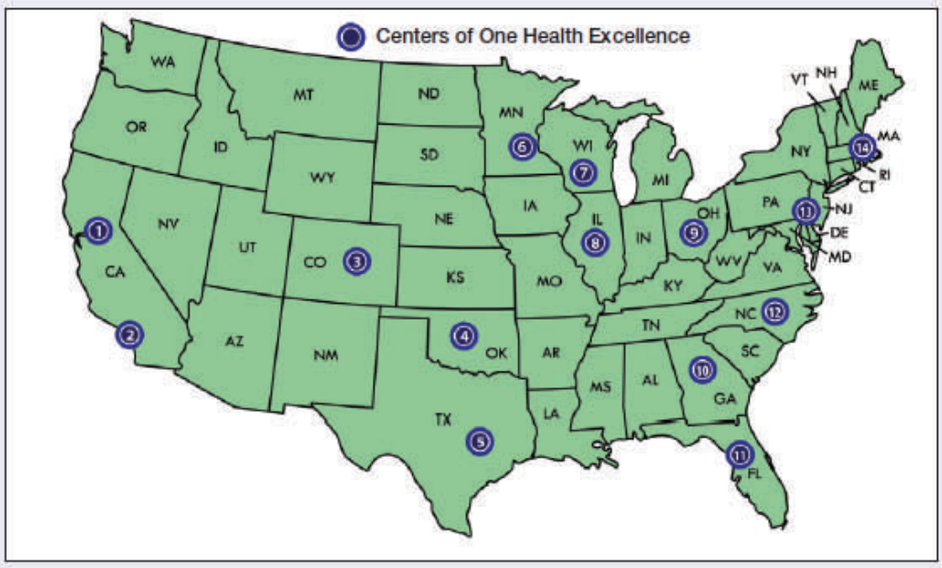
Institutional support for student involvement is vital to the success of One Health educational programming.

To solidify long-lasting, interdisciplinary approaches, we propose a summer "One Health Institute" workshop. Coursework and group problem solving sessions would bring students from multiple disciplines together to tackle difficult issues. The University of Minnesota's Public Health Institute, the Envirovet program, and the global health case competition model recently adopted by several schools, are good applications of this approach. Leadership and communication training, as well as incentives to further One Health education at students' home institutions, would contribute to the success and breadth of these programs.

Institutional support for student involvement is vital to the success of One Health educational programming. There are many domestic and international instances of successful long-term collaborative relationships between and within universities and health organizations; these are most frequently successful when they tackle discreet topics or problems and when people with varied backgrounds can sit down face-to face to work on solutions. We are proud to be part of one such collaboration: individuals from various departments of Duke University, North Carolina State University, and the University of North Carolina, along with private and non-profit biotechnology and research centers have come together to form the Triangle Global Health Consortium. This organization strives to foster relationships among professionals in diverse fields and to support continuing education relating to the role of global health.

Duke University, North Carolina State University, and the University of North Carolina, along with private and non-profit biotechnology and research centers have come together to form the Triangle Global Health Consortium.

WebPanel 1. Potential Centers of One Health Excellence (COHE) in the contiguous US



By analyzing the proximity of academic centers for veterinary medicine (Vet), medicine (Med), environmental science (Env), and public health (PH) across the US, we identified those hotspots of high potential for One Health collaboration. "All" indicates co-location of all four disciplines at one institution; subscripts indicate multiple programs in the COHE area. (1) All: University of California (UC) Davis; (2) Vet: Western University of Health Sciences; Med[3]: UC Irvine (UCI), UC Los Angeles (UCLA), University of Southern California (USC); Env[4]: UC Irvine, UC Riverside, UCLA, University of Redlands; PH[5]: California State University (CSU) Northridge, CSU Long Beach, UCLA, UCI, USC. (3) Vet: Colorado State University (CSU); Med: University of Colorado (UC) Denver; Env[3]: CSU, UC Boulder, UC Denver; PH[2]: UC Denver, University of Northern Colorado; Govt Agency: US Geological Society National Wildlife Health Center. (4) Vet: Oklahoma State University (OSU); Med: University of Oklahoma (UO); Env[2]: OSU, UO; PH: UO. (5) All: Texas A&M University. (6) All: University of Minnesota. (7) All: University of Wisconsin Madison. (8) All: University of Illinois Urbana Champaign. (9) All: The Ohio State University. (10) Vet: University of Georgia (UGA); Med[2]: Emory University (EU), Morehouse School of Medicine; Env[3]: EU, UGA, Georgia Institute of Technology; PH[4]: EU, UGA, Georgia State University, Govt Agency: Centers for Disease Control and Prevention. (11) All: University of Florida. (12) Vet: North Carolina State University (NCSU); Med[2]: Duke University (DU), University of North Carolina (UNC), Env[3]: DU, UNC, NCSU; PH: UNC. (13) Vet: University of Pennsylvania (UP); Med[4]: Temple University, Thomas Jefferson University, UP, Drexel University (DU); Env[4]: University of Delaware, DU, UP, Princeton University; PH: UP. (14) Vet: Tufts University (TU); Med[5]: University of Massachusetts (UM) Worcester, Boston University (BU), Harvard University (HU), TU, Brown University; Env[5]: Brown University, BU, TU, UM Boston, UM Amherst; PH[4]: BU, Harvard University, TU, UM Amherst.

We propose propagating this model with a focus on student involvement and One Health education; to this end, we have identified fourteen potential Centers for One Health Excellence (COHE) in the contiguous US. The proposed locations each contain multiple environmental and health-related higher education centers within a reasonable

A blue heron uses oil boom as a hunting platform

We therefore submit a call to leaders of educational institutions to create a forum for One Health education, thereby paving the way for interdisciplinary work and integrated solutions to the world's most challenging problems.

Oil from the Deepwater Horizon oil spill in the surf washing up on an Alabama beach.

distance of each other (one hour's drive). A map of potential COHE has been reproduced here from the original article in Frontiers in Ecology and the Environment (see figure below). With the advantage of proximity, the institutions highlighted by this proposal are poised to lead the way to a new approach to global health and science education.

By training the next generation of researchers and health practitioners to utilize One Health concepts, we can accelerate not only development of health research and delivery programs, but also improvements in public health effectiveness, and the creation of sustainable development and conservation programs. We therefore submit a call to leaders of educational institutions, particularly those in potential COHE, to create a forum for One Health education, thereby ensuring that interdisciplinary work continues to grow while paving the way for integrated solutions to the world's most challenging problems.

The original article abstract can be found at: http://www.esajournals.org/doi/abs/10.1890/090159

Low-resolution pdfs are available upon request by contacting Meredith Barrett (Meredith.barrett@duke.edu).

Meredith Barrett is a PhD candidate in the University Program in Ecology at the Nicholas School of the Environment at Duke University. She is working to identify the health consequences of human development on lemur populations in Madagascar. She, along with Aaron Stoertz, coordinate the Global Health Working Group, a student-run interdisciplinary forum at Duke University dedicated to educating students about global health issues.

Timothy Bouley is currently studying global health adaptation to climate change while pursuing degrees in medicine at Duke University and environmental change at Oxford University.

Aaron Stoertz is pursuing his MSc in Global Health at the Duke Global Health Institute and has a certificate in epidemiology from the University of North Carolina's Gillings School of Global Public Health. His current focus is human resources for health and health care distribution in underprivileged communities and nations.

Rosemary Stoertz is a student at the College of Veterinary Medicine at North Carolina State University. Along with several other NCSU students, she started a One Health Intellectual Exchange Group in 2009. The group brings together students and professionals from varied backgrounds to discuss One Health projects and possibilities.

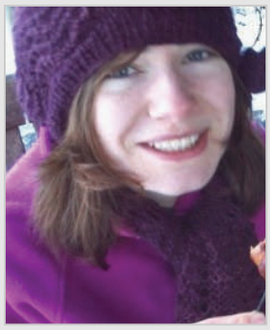
Introduction to *" My Future Veterinary Career in Human Health"*

by Silvia Alonso Alvarez,
Lecturer in Veterinary Public Health, Royal Veterinary College, UK

The European Veterinary Week (EVW) is an annual event organized by the European Commission and the Federation of Veterinarians of Europe which aims to promote the role of veterinarians in society. In 2009 the focus of the EVW was on the "One Health" concept and the role of the European Union in safeguarding the health of ani-

mals, as well as the health of citizens via safe food and the prevention of zoonoses.

Every year, veterinary organizations across Europe undertake various activities endorsing the EVW. Last year, the Royal Veterinary College (http://www.rvc.ac.uk/), the largest and oldest of the seven Veterinary Colleges in the UK, coordinated a national student essay competition. Students had to write an essay about the links between animal and human health and the implications of this for veterinarians and specifically for the student's own future career. The best essay from the Royal Veterinary College was written by Sarah Farringdon (second Prize in the national competition). Sarah's article follows on the next page.



Sarah Farrington

I hope to soon join a profession that is concerned with safeguarding both animal and human health and welfare.

My Future Veterinary Career in Human Health

Sarah Farrington, BVetMed Student

As a veterinary student, I hope to soon join a profession concerned with animal health and welfare. Safeguarding humans, however, is an important aspect of the job, and not just for state veterinary officers. The European Commission recognizes the importance of animal-human health links and the EU Animal Health Strategy 2007-2013 encompasses prioritizing animal health issues, a single legal framework, research, surveillance, threat prevention and preparation for emergencies, in an effort to combat animal-human health problems. How does this affect vets in practice? In answer, let's consider a day in the life of a first opinion mixed practice vet, which is where I soon hope to be.

Formulating a herd health plan
Courtesy National Dairy Farm Assured Scheme

How is the daily practice of veterinary medicine affected by this mission to combat animal and human health problems?

At 4.30am our vet is called out to a dystocic calving. On arrival the vet dons clean protective wear, which he washes and disinfects thoroughly again some time later, having successfully delivered the calf. Although obvious, this step is important to maintain farm biosecurity; after all, what better fomite for zoonotic and other disease than a vet? Biosecurity on the farm, as well as at a national level and across borders, is vital to public and animal health and vets play a role in its maintenance.

The vet nips home for a cup of coffee and glances over yesterday's paper. Veterinary public health issues can be emotive topics which frequently populate the media e.g. recent *E.coli* outbreaks and extensive avian and swine influenza coverage. We won't readily forget reports of the 2001 Foot and Mouth Disease outbreak. This was devastating for animals, livestock producers and the public; although not zoonotic, the impact on humans was great. Vets are involved in the midst of such outbreaks and their vigilance for exotic and notifiable diseases can enable prompt action.

As the vet moves on to the sports section, he adds a splash of milk to his coffee. The producer of the milk is part of the National Dairy Farm Assured Scheme and their vet was involved in forming a herd health plan and advising how to meet the required health, welfare, hygiene, traceability and biosecurity standards. Coffee finished, our vet heads into work.

A dog's microchip and documentation being check
Courtesy DFRA

Morning surgery is busy. Animal-human health links are not restricted to food producing animals, but extend to companion animals, with dogs alone reported to carry over sixty zoonoses worldwide. Our vet routinely advocates anthelmintic products which protect animal health but are also important to humans. One example is hydatid disease;

Prevention of toxic contamination of food products is an important role of a vet.....

.....and identification of food producing animals allows product traceability.

With the current challenges and the continued threat of emerging and spreading disease, any vet can expect to play an important role as the link between animal and human health.

the requirements and should keep owners informed and help preserve cross border biosecurity.

After a busy morning the vet finds a moment to quickly eat a ham sandwich. The ham will have been subject to various veterinary regulations during production, as animal food products are an important source of zoonoses. Currently the EU's most commonly reported human zoonosis is campylobacter, with 57590 UK cases reported in 2007. This is likely to be the tip of the iceberg, and can be serious in young and elderly people. It is concerning that fluoroquinolone use in poultry has led to fluoroquinolone resistant campylobacter infecting humans. When prescribing antimicrobials, vets should consider their importance in human health, and withdrawal times should be adhered to.

The afternoon is spent mainly attending farm calls, starting with some TB testing. Fortunately due to milk pasteurisation, zoonotic transfer of TB in the UK is now low, although the cost of compensation for bovine tuberculosis loses is high. It cost circa £140K in the UK from the year 2002 to 2005 inclusive, and controlling this disease is important to the general public as well as livestock.

The next call is to euthanize a dairy cow. The cow is over 48 months old and so, under EU legislation must be tested for BSE. The BSE link to human new variant CJD was first suggested in 1996. The EU launched a monitoring programme, prohibited animal byproduct use in livestock feed, and previously banned British beef exportations. So far this year just five UK bovine BSE cases have been confirmed, unlike the 37000 plus clinical cases in 1992. Vets have been involved at VLA laboratories, in abattoirs with ante-mortem inspections, and out in the field understanding which animals require testing, remaining vigilant for and notifying the divisional veterinary manager of any BSE signs.

The final visit is to complete an equine passport. The Horse Passport Regulations 2009 act No.1611, implementing Commission Regulation (EC) 504/2008, has made equine microchipping mandatory and reinforces that all member state horses require a passport. Identification of horses ensures veterinary products that could endanger humans, such as metronidazole or chloramphenicol, don't enter the food chain. Prevention of toxic contamination of food products is an important role of a vet, and identification of food producing animals allows product traceability.

After just one day, the vet returns home having encountered various public health responsibilities and opportunities. This is by no means an exhaustive list of zoonoses and animal-human health issues in the UK, let alone the rest of the world. It does however illustrate how prospective students like me can expect to be heavily involved with these issues in their future career. With the current challenges and the continued threat of emerging and spreading disease, any vet can expect to play an important role as the link between animal and human health.

References:

http://ec.europa.eu/food/animal/diseases/strategy/

Sarah Farrington is a BVetMed Student at the Royal Veterinary College, UK.

New One Health Course Launched

Patricia A. Conrad, DVM, PhD

The One Health Center of expertise was launched as part of the University of California Global Health Institute in November 2009 (http://www.ucghi.universityofcalifornia.edu/). In April, One Health Center faculty at UC Davis and UC Riverside launched a two-credit course on One Health that was co-taught by Michael Wilkes (UCD Medical School) and Co-Directors of the Center Patricia Conrad and Anil Deolalikar. Both students and faculty in the course represented the unique transdisciplinary focus of the One Health approach to global health. Teleconferencing technology was utilized in the biweekly two-hour sessions to link the six medical students and residents at the UC Davis Medical Center in Sacramento with the nine graduate students at each of the main campuses in Davis and Riverside.

One Health: Water, Animals, Food and Society

The University of California Global Health Institute's course on One Health promotes an integrated trans-disciplinary approach to global health problems.

Patricia Conrad, DVM, PhD
UC Davis

Anil Deolalikar, PhD
UC Riverside

Co-Directors of the University of California's One Health Center

The graduate students enrolled in the course at UC Davis came from International and Community Nutrition, International Agricultural Development, the Center for Health & the Environment, and the School of Veterinary Medicine. At UC Riverside, the graduate students were drawn from the Departments of Entomology, Environmental Sciences, and Cell, Molecular and Developmental Biology, and Sociology. Similarly, the faculty who participated from all three sites came from diverse disciplines, including economics, microbiology, epidemiology, medical ethics, environmental engineering, nutrition, medicine, environmental public health, and parasitology.

Dr. Michael Wilkes (center) speaking with students.
Courtesy UC Davis Health System

The overall goal of the course was to introduce students to the core concepts involved in One Health, particularly the promotion of an integrated transdisciplinary approach to global health problems. Students learned how the health of humans, animals and the ecosystems they share are closely linked. Each session focused on real case problems ranging from water scarcity, waterborne disease and watershed management in Tanzania and Kenya, tsetse fly control in Ethiopia, and zoonotic disease transmission in California. In addition, students were exposed to techniques of cost-effectiveness and cost-benefit analysis of global health interventions.

Students learned how the health of humans, animals and the ecosystems they share are closely linked.

Students worked in small break-out groups to brain storm about problems and identify solutions to One Health iterative cases. These were then shared with the entire group of faculty and students via the teleconference systems with audio and video capabilities.

One Health Newsletter

Contributors:

Continued.....

Dr. Laurie Harris, one of the veterinary graduate students in the class led a One Health case discussion based on her graduate work on the health of the mountain gorillas and neighboring human communities in Rwanda. Afterwards Laurie commented, "Leading a One Health discussion was a fun way to share ideas and, thanks to the help of my colleagues, to think more deeply about the interdisciplinary nature and effectiveness of my own research."

Dr. Patricia Conrad is Professor of Parasitology at the School of Veterinary Medicine, University of California, Davis. She is also Co-Director of the One Health Center of Expertise for the University of California Global Health Institute

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.

Coming Events:

9th European Wildlife Diseases Association Conference

"Healthy wildlife, healthy people"

On the Dutch island of Vlieland

September 13-16, 2010

http://www.ewda-2010.nl/default.aspx

Zoonoses: Understanding the Animal Agriculture and Human Health Connection

Organized by Farm Foundation

Washington, D.C

September 23-24, 2010

http://www.farmfoundation.org/webcontent/Zoonoses-Understanding-the-Animal-Agriculture-and-Human-Health-Connection-1727.aspx?z=85&a=1727

Contributors:

Thomas P. Monath, MD
Kleiner Perkins Caufield & Byers

Glenn Morris, Jr., MD, MPH & TM
Emerging Pathogens Institute
University of Florida

Michael T. Osterholm, PhD, MPH
University of Minnesota

Peter M. Rabinowitz, MD, MPH
Yale University

Ralph C. Richardson, DVM, Dipl. ACVIM
Kansas State University

James Steele, DVM, MPH
Professor Emeritus
University of Texas

Ana Viamonte Ros, MD, MPH
Surgeon General
Florida Department of Health

Jedd D. Wolchok, MD, PhD
Memorial Sloan-Kettering Cancer Center
Memorial Sloan-Kettering Cancer Center

John (Jack) Woodall, MA, PhD
Director (retd.)
Nucleus for the Investigation of Emerging Infectious Diseases
Institute of Medical Biochemistry
Federal University
Rio de Janeiro, Brazil

Coming Events:

One Health Initiative Symposium: Vaccination of Animals for Prevention and Control of Zoonotic Diseases

American Society for Tropical Medicine and Hygiene– 59th Annual Meeting

Atlanta, Georgia (USA)

November 3-7, 2010

http://www.astmh.org/Home.htm

North American Veterinary Conference (NAVC) 2011

"One Health" Session

Orlando, Florida (USA)

January 15-19, 2011

http://tnavc.org/

One Health 2011 Congress Melbourne Convention Centre

Victoria, Australia

February 14-16, 2011

http://onehealth2011.com/

13th ISVEE Conference, 2012

The International Society for Veterinary Epidemiology and Economics

"Building Bridges - Crossing Borders"

Maastricht, Netherlands

August 20-24, 2012

http://isvee13.org/

One Health Newsletter

Recent One Health Publications:

- **The One Health Initiative: A profile of the One Health movement from a chief advocate, Dr. Laura Kahn.** International Innovation Magazine: Research Media Ltd - Healthcare by alovering July 21, 2010,

  http://www.research-europe.com/index.php/2010/07/dr-laura-kahn-on-the-one-health-initiative/

- **One Health: The Intersection of Humans, Animals and the Environment.** Institute for Laboratory Animal Research (ILAR) Journal Volume 51, Number 3. Issue Editor: James G. Fox, DVM, MS, DACLAM

  http://www.ilarjournal.com/5103pdfs.html

- **Evolution of a transdisciplinary ''One Medicine–One Health'' approach to global health education at the University of California, Davis.** Patricia A. Conrad , Jonna A. Mazet , Deana Clifford, Cheryl Scott, Michael Wilkes, Preventive Veterinary Medicine 92 (2009) 268–274.

  http://www.elsevier.com/wps/find/journaldescription.cws_home/503315/description

- **Effective, Broad Spectrum Control of Virulent Bacterial Infections Using Cationic DNA Liposome Complexes Combined with Bacterial Antigens.** Ireland R, Olivares-Zavaleta N, Warawa JM, Gherardini FC, Jarrett C, et al Plus Pathog 6(5): e1000921. doi:10.1371/journal.ppat.1000921

  http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1000921

- **Novel Therapeutic Approach Shows Promise Against Multiple Bacterial Pathogens.** NHI NEWS, Thursday, May 27, 2010. Contact:Ken Pekoc

  http://www.nih.gov/news/health/may2010/niaid-27.htm

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

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