The One Health Newsletter is a collaborative effort by a diverse group of scientists and health professionals committed to promoting One Health.

One Health Newsletter

Volume 8, Issue 1

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

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An Analysis of the Linkages Between Public Health and Ecosystem Integrity: Part 6 of 6

Steven A. Osofsky, DVM, Anila Jacob, MD, MPH, and Christopher D. Golden, PhD, MPH

Health & Ecosystems: Analysis of Linkages (HEAL) is a consortium of more than 25 institutions collaborating to analyze and quantify relationships between the state of ecosystems and public health. The consortium comprises many of the world's premier public health and environmental science institutions working in both developing and developed countries. HEAL's mission is to increase support for integrated public health and environmental conservation initiatives as intimately related, interdependent challenges. A cross-sectoral attitudinal change will ultimately help to improve public health outcomes, equity, and resilience for some of the world's poorest people, often living in the world's most remote areas, while simultaneously conserving some of the most important natural landscapes and seascapes left on earth. It is a mission directly aligned with that of One Health (Barrett and Osofsky, 2013).

The HEAL consortium believes that there are important public health impacts associated with changes in the state of different ecosystems and that, frequently, degradation of these ecosystems leads to negative public health impacts. However, relatively little peer-reviewed literature delves into the mechanisms underlying potential causal relationships between ecosystem degradation and public health outcomes. Policy-makers interested in understanding these relationships are left with largely anecdotal information that is clearly insufficient for informing decision-making in terms of conservation, public health, or both.

Photo by Mike Kock, Wildlife Conservation Society

A key component of HEAL's approach is to explore what is currently known regarding linkages between human health and natural ecosystems, as a foundation for prospective applied research. In this 6-part series, we explored what is currently understood in terms of linkages between the state of various ecosystems and major public health challenges. We focused on communicable diseases in Volume 6 Issue 4 of the One Health Newsletter, non-communicable diseases in Volume 7 Issue 1, nutrition in Volume 7 Issue 2, mental health in Volume 7 Issue 3 and vulnerability to extreme events in Volume 7 Issue 4. In our last installment, we focus on ecosystem degradation and the loss of biopharmaceuticals.

Currently Understood Linkage #6: Ecosystem degradation and the loss of biopharmaceuticals

An estimated 52,885 plant species are used globally as medicines (Schippmann et al. 2012): approximately one sixth of all global botanical diversity (Myers et al. 2000). The last several decades have seen a relative decrease in the introduction of new drugs despite increased investment in research and development (Scannell et al. 2012). At the same time, pathogens that cause common diseases such as tuberculosis, pneumonia, and skin infections are increasingly developing resistance to currently available antibiotics. Infectious disease specialists are particularly concerned about the growing public health threats posed by antimicrobial resistance and the diminishing antibiotic drug pipeline

(Spellberg et al. 2008). In the United States, more than half of the one hundred most commonly prescribed medicines are derived from nature (Bernstein and Ludwig 2008). It is estimated that about two-thirds of anticancer drugs and antibiotics are derived from natural sources (Kingston 2011). Intact ecosystems also directly provide local communities with medicinals from nature that are critically important in preventing and treating disease. It is estimated that up to 80% of residents of developing countries have used natural medicines (Newman et al. 2008).

Medications to treat some of the world's most common diseases are derived from natural systems, including aspirin, the malaria drug quinine, and the anticoagulant warfarin (Newman et al. 2008). New discoveries from nature continue to be made as well; scientists recently announced that melittin, a chemical found in bee venom, has been shown to have activity against the human immunodeficiency virus (HIV) (Hood et al. 2013). Similarly, in Madagascar, natural agents from an ocean sponge were found to have antiproliferative activity against ovarian cancer cells (Harinantenaina et al. 2013). One recent analysis found that more than twenty new nature-based medications were commercially launched from 1998 to 2007, confirming that natural systems remain an important source of new drugs (Kingston 2011).

Photo credit: Christopher Golden, 2007

The widespread degradation of ecosystems globally threatens the availability of the microbial, plant, and animal species from which natural medicines are derived (Barrett and Osofsky 2013). Biodiversity loss poses a significant threat to new drug discovery, particularly in an era characterized by increasing antibiotic resistance and a rising burden of chronic diseases worldwide.

In Appreciation

The One Health Newsletter Editorial Staff would like to extend our sincere thanks to Dr. Osofsky, Dr. Jacob, and Dr. Golden for contributing this informative six part series. Your time and efforts spent working with us are much appreciated. We would also like to thank Dr. Meredith Barrett, OHNL Editorial Board member, who has been working behind the scenes to coordinate these articles. The newsletter staff and readership have greatly enjoyed learning from this series!

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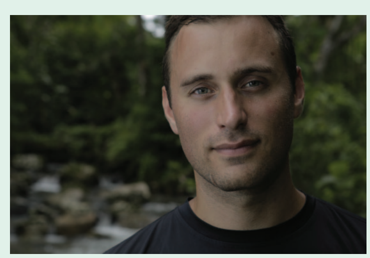


Photo Credit: Jon Betz/National Geographic

Tacaribe Virus in Florida: An Example of Bottom-Up Discovery of Potential Human and Animal Pathogens

Katherine A. Sayler, PhD

Tick-borne diseases (TBDs) are becoming increasingly recognized for their public health relevance, as ticks are surpassed only by mosquitoes as arthropod vectors of human and animal disease. Emerging tick-borne agents capable of causing human disease are being discovered at a rapid pace although TBDs have a long, documented history in veterinary medicine. In fact, establishment of tick vectored *Babesia bigemina* as the causative agent of Texas cattle fever in 1893 predates discovery of the vectors of malaria and yellow fever, as well as the insight that fleas transmit plague-causing bacillus (1). Since that early discovery, a new disease-causing agent transmitted by a tick vector has been discovered globally every 5-7 years, on average. Thanks in part to the advent and widespread use of molecular tools, the pace of TBD discovery has changed expeditiously over the past 30 years and the number of epidemiologically important and distinct diseases has rapidly increased. For example, in 1990 only two tick-associated diseases were reportable in the United States: Rocky Mountain spotted fever and tularemia (2). Today at least ten TBDs are recognized in the United States including tick-borne bacterial infections such as anaplasmosis, babesiosis (3), ehrlichiosis (caused by *Ehrlichia chaffeensis* and *E. ewingii*, which are responsible for the monocytotrophic and granulocytotrophic forms of human ehrlichiosis, respectively); Lyme borreliosis caused by several genospecies of Borrelia (most notably *Borrelia burgdorferi* in the U.S.); *Borrelia hermsii* and other *Borrelia* spp. which cause tick-borne relapsing fever (4), and tick-borne viruses including Colorado tick fever (5), Powassan virus (6), and Heartland virus (7).

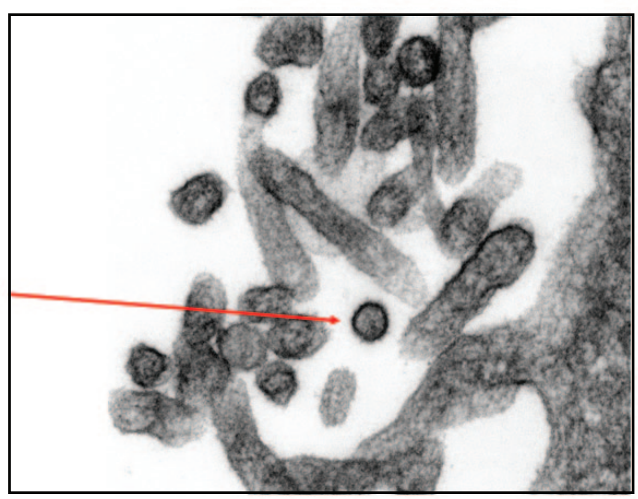
Since their discovery and recognition as agents of human disease, the reported case incidences have increased for many of these important tick-borne pathogens, often dramatically, including *Anaplasma phagocytophilum* and *Ehrlichia chaffeensis* (8), spotted fever group rickettsiae (9), and *Borrelia burgdorferi* (10). Some TBDs endemic to North America are associated with long-term morbidity or relatively high case fatality rates that generate considerable fear and public health concerns that outweigh actual disease burden. In particular, fear of Lyme disease in the southeastern United States where the disease is not considered to be endemic, has captured public attention and led to debate among researchers and the public, alike. In contrast, other less recognized diseases, such as *Ehrlichia* spp. may cause disease that goes unrecognized by many medical practitioners, thereby underestimating the true impact on human or animal health levied by these agents (11). Furthermore, for the less recognized tick-borne pathogens, consistent surveillance efforts are entirely passive and reported disease incidence rates can vary widely from year to year. This is often because proactive surveillance, which can act as an early warning system for pathogens, does not take place. Additional factors that can lead to fluctuations between years include changes in definitions of disease and alterations to reporting practices.

Amblyomma americanum adult female
Photo by Katherine Sayler

A number of factors which may be working synergistically, but are often poorly understood, are likely contributing to upward trends and yearly fluctuations in TBD incidence abroad and in the US. These factors include expanding ranges of tick vectors, better diagnostic assays, and improved awareness among physicians, against a backdrop of highly variable regional and local surveillance for tick-borne diseases. Additionally, climate change as a phenomenon affecting tick range, activity, reproduction, behavior, and the rate of human/vector contact has also been discussed as having an impact on TBD incidence globally (12–14). Other, more subtle trends, including land use and habitat fragmentation, suburbanization, increased outdoor recreation, and changes in wildlife populations may also influence disease incidence in people and in animals (11). For example, in the Czech Republic, researchers recently observed that counter-urbanization (movement from urban, densely populated areas to rural areas) correlated with residential exposure and extension of the seasonal case distribution of Lyme borreliosis (15). Complex interactions involving human land use, species richness and diversity of both the vector and wildlife reservoirs have the potential to affect the circulation of tick-borne diseases in a geographic area. In particular, the role of wildlife reservoirs in the maintenance of TBDs is important for making predictions about disease "hotspots" and likely locations of disease emergence (16-18). Therefore, a system-wide, bottom-up One Health approach is important for understanding human exposure risk to tick-borne pathogens.

This type of approach has led to our recent re-discovery of a lost arenavirus in highly prevalent, aggressive, human and animal biting tick species in Florida (19). The virus we found, the Tacaribe virus, was first discovered in the 1950s in Trinidad during rabies surveillance. (20). The presence of the virus in ticks in the U.S. is of particular interest because Arenaviridae are known to cause severe hemorrhagic disease in humans, particularly in parts of sub-Saharan Africa, and in Central and South America. Humans typically become infected with an arenavirus through contact with excreta from infected rodents and it is highly unusual to find this type of virus associated with a tick vector. This is especially alarming because Tacaribe virus is closely related to the most highly pathogenic viruses that cause up to 30% mortality in infected patients, including Junin virus. Furthermore, the wildlife reservoir for this zoonotic virus has never been identified. We found that the tick-derived isolate is nearly identical to the only remaining isolate from Trinidad (TRVL-11573), with 99.6% nucleotide identity across the genome. We also developed a quantitative RT-PCR assay to test for viral RNA in host-seeking ticks collected from 3 Florida state parks. Virus RNA was detected in 56/500 (11.2%) of surveyed lone star ticks. As this virus was isolated from ticks that readily parasitize humans, the ability of the tick to transmit the virus to people should be evaluated. Furthermore, reservoir hosts for the virus need to be identified in order to develop risk assessment models of human infection.

The benefit of using a bottom-up approach for tick-borne agents is early identification of the virus in the environment. Detection of the virus in an appropriate sentinel species (the tick) does not rely on waiting for human cases associated with severe disease to occur. Instead, this type of approach can be used to make a proactive and predictive, rather than reactive response to potentially serious disease-causing agents. However, this can only be accomplished with support



Electron microscopy image of Tacaribe virus
Image courtesy of Katherine Sayler

from funding sources and the development of successful, multidisciplinary teams. This is particularly true of viral pathogens of zoonotic origin where a vector species is implicated. The United States Agency for International Development (USAID) has applied this approach as part of its PREDICT initiative that is focused on risk determination, capacity building and pathogen discovery. Domestically, disease surveillance efforts in vectors and wildlife reservoirs remain largely reactive. Only when funding for active surveillance and interdisciplinary working groups increases can we expect to see further improvements in pathogen discovery and the use of vectors, rather than humans, as sentinels of emerging disease.

A multidisciplinary team including a virologist (Dr. John Lednicky), a pathologist (Dr. William Clapp), a veterinarian (Dr. Rick Alleman), a biochemist (Dr. Anthony Barbet) and vector biologist (Dr. Katherine Sayler, author) worked together to isolate the Tacaribe virus from ticks and perform the experiments described above.

Dr. Katherine Sayler is a postdoctoral associate at the Institute of Food and Agricultural Sciences studying the vector ecology of epizootic hemorrhagic disease and related viruses. She has studied tick-borne pathogens and wildlife disease ecology for the past 10 years both in the field and in the laboratory and hopes to continue to work on emerging vector-borne zoonoses.

Do we need One Health Surveillance?

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The growing discussion and promotion of One Health approaches in many different forums, both scientific and non-scientific, is an indication of the increasing popularity of integrated strategies for improving population health. If One Health remains popular and, over time, matures into One Health Practice (OHP), there may be requirements for new infrastructure to support this emerging field of public health. Public health surveillance is a necessary component of the infrastructure that supports current public health and veterinary public health practices. A relevant question is then: as One Health continues to grow, will there be a need for new or different surveillance methodologies to support OHP? In other words - will there be a need for One Health Surveillance (OHS)?

iSDS INTERNATIONAL SOCIETY FOR DISEASE SURVEILLANCE

Defining OHS is a first step towards answering this question. Building on the WHO definition of Public Health Surveillance (1), we have defined OHS as: the collaborative, on-going, systematic collection and analysis of data from multiple domains to detect health related events and produce information which leads to actions aimed at attaining optimal health for people, animals, and the environment.

Since by this definition the purpose of OHS would be to produce information to support OHP, we could be more specific by asking: is there a need for new information or a different way of using existing information to support OHP?

This is a question that a small group of researchers have recently been trying to answer, working with the International Society for Disease Surveillance (ISDS) (2) and with support from the Skoll Global Threats Fund (3). ISDS is a Boston-based non-profit organization whose mission is to "improve population health by advancing the science and practice of surveillance to support timely and effective prevention and response." The Skoll Global Threats Fund is committed to "safeguarding humanity against global threats."

Their research approach was based on a theory for population health surveillance (4) which defines the pre-requisites to the establishment of new surveillance activities. These prerequisites include: 1) dissatisfaction with current surveillance and an accompanying need for surveillance information or knowledge that is currently unavailable; and 2) motivation to eliminate the dissatisfaction and need. The research group adopted a two-step process to gauge whether these conditions exist and to generate tangible solutions for moving forward.

The first step was to survey surveillance stakeholders to determine whether they feel there is a need for OHS or for OHS information; whether there is motivation to move forward; and to identify current challenges for moving OHS forward. A questionnaire was developed and sent by email to people involved in surveillance, including the ISDS general contact list, members of the International Conference on Animal Health Surveillance (ICAHS) email list, WHO SEARO Focal Point contacts, and the South Asia Regional Workshop contact list. In addition, the questionnaire was advertised on the ISDS Twitter feed and the ISDS Community Forum. Completed questionnaires were returned from 185 people from 44 countries. Respondents included people working in public health (52%), animal health (19%), environmental health (2%), and in multiple domains (25%). Respondents were engaged in the practice of surveillance and the use of information from surveillance to improve population health within their reported domains.

The second step was to engage surveillance stakeholders in a workshop aimed at developing and prioritizing practical solutions to some of the more important challenges, as identified by the survey respondents. Attendants at the ISDS annual conference in Philadelphia, PA, on Dec 10-11, 2014, were invited to participate in the workshop that was held at the conference venue. With 61 registered participants from 6 countries, the workshop began with a short description of the study and a brief summary of preliminary survey results, followed by presentations from three speakers who discussed One Health and One Health Surveillance from various perspectives. Dr. Leslie Bulaga, USDA, APHIS, Veterinary Services spoke about OHS related to livestock and poultry diseases in the U.S.; Dr. Marlo Libel, Skoll Global Threats Fund, spoke about OHS related to zoonotic diseases in Central and South America, and Julia Gunn, Boston Public Health Commission, spoke about OHS issues in a large metropolitan public health department in the U.S. Workshop participants were divided into three groups and tasked with developing practical solutions under the following topics: 1) training and resources, 2) tools and methodologies and 3) cross-agency communication and collaboration. Each group nominated a speaker who presented their solutions to all the participants. The last step was a participatory process in which participants were tasked with prioritizing the solutions.

The research team is currently completing the data analysis from the survey and workshop and will distribute the findings broadly. Preliminary results indicate that a very large proportion (85%) of survey respondents reported that OHS was needed and that their work would benefit from having OHS. The solutions developed by workshop participants will be communicated to a wide audience, so groups working in One Health contexts will have potential solutions for some of the problems and issues they are facing.

ISDS has initiated a One Health Surveillance (OHS) working group to communicate the need and value of OHS, to promote OHS in support of OHP, and to develop other strategies for supporting and enhancing surveillance to meet the needs of OHP. The working group is currently inviting anyone with an interest in OHS to consider joining the group.

We thank ISDS for providing coordination and for hosting the workshop, as well as the Skoll Global Health Threats Fund for financial support. Most of all, we would like to thank everyone who participated in the survey and the workshop.

For information about or to join the OHS working group, please visit the OHS working group website: http://www.syndromic.org/programs/one-health-surveillance

Chikungunya Virus Infection: Ecoepidemiological Considerations of a New Threat for Latin America

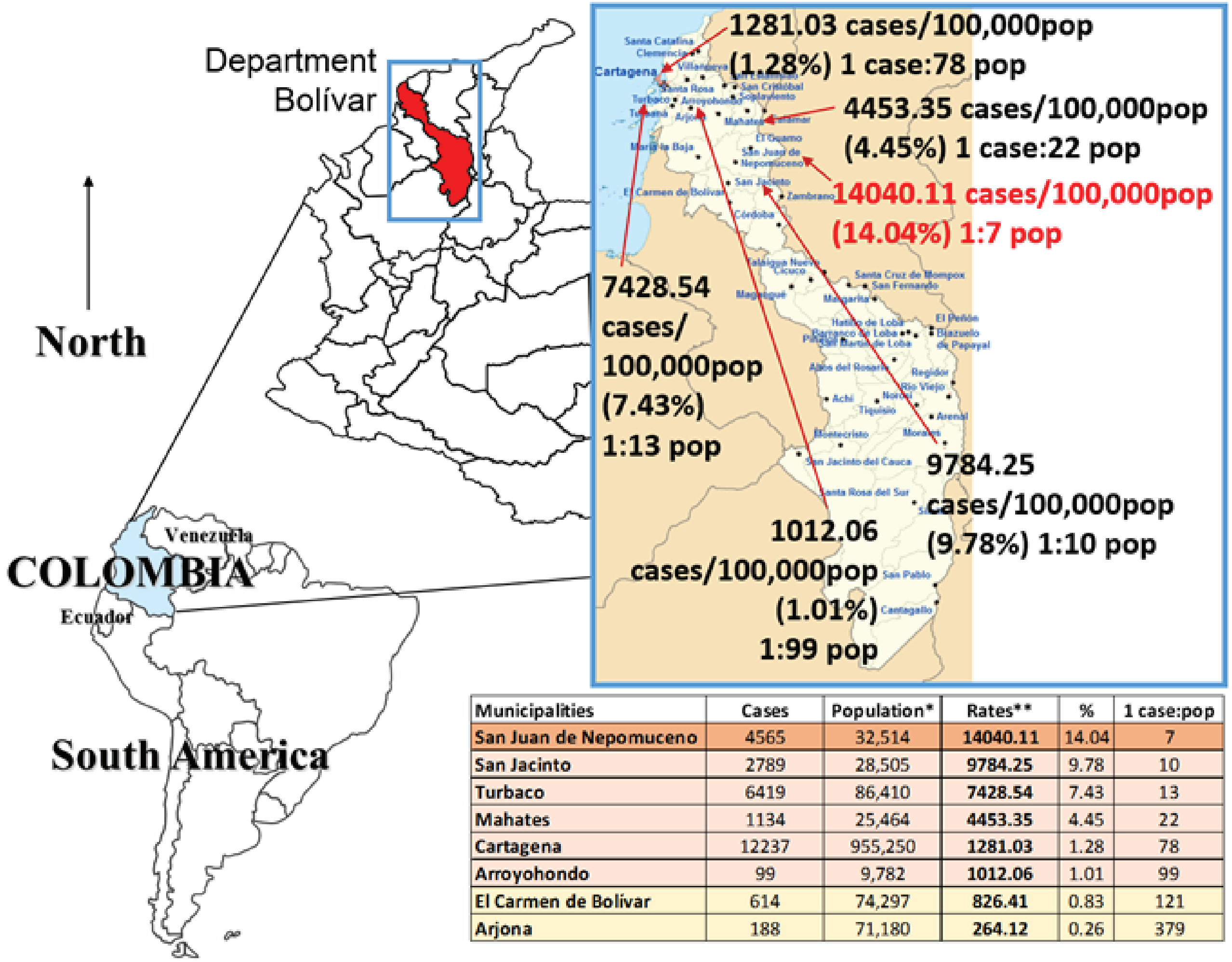
Alfonso J. Rodriguez-Morales, MD, MSc, DTM&H, FRSTM&H, FFTM RCPS, PhD(c)

During the last year multiple countries from across the Americas experienced the arrival of a new emerging infectious disease, Chikungunya virus (CHIKV) infection (Clouet-Huerta, Alfaro-Toloza & Rodriguez-Morales, 2014). For the first epidemiological week of 2015, a cumulative incidence rate of 116 cases/100,000 pop. was reported by the Pan-American Health Organization (PAHO) (1,118,732 cases) (PAHO, 2015). Beyond that, some countries reported rates much higher, such as those in the Latin Caribbean area: Martinique (18,246.3 cases/100,000 pop.), Guadeloupe (17,517.2 cases/100,000 pop.), Saint Barthélemy (17,247.2 cases/100,000 pop.), and Saint Martin (15,755 cases/100,000 pop.), among others (PAHO, 2015).

In some countries domestic inequity influences the incidence of CHIV infection. For example, in Colombia, where 96,433 cases were reported (up to the epidemiological week 53 of 2014) (National Institutes of Health of Colombia, 2014), for a cumulative incidence rate of 202.33 cases/100,000 pop., many municipalities in the north of the country, or the Caribbean coast region, reached rates > 1,000 cases/100,000 pop.: San Juan de Nepomuceno reported more than 14% of its population having CHIKV during the year (14,040.11 cases/100,000 pop.) (Figure).

The scenario is complicated by the presence of existing arbovirus and vectors (Rodriguez-Morales & Paniz-Mondolfi, 2015). In 2013, the year CHIKV began to spread throughout the Americas, this virus arrived first to areas where Aedes spp was already an efficient vector of dengue virus (DENV) serotypes 1-4. Currently, CHIKV is present in all tropical countries of South

Typical balcony in the colonial walled city of Cartagena de Indias, Colombia. The city was founded on June 1, 1533. The colonial walled city and fortress was designated in 1984 by the United Nations Educational, Scientific and Cultural Organization as a World Heritage Site. CHIKV infection rate is high in this city, which increases the risk to travelers.
Photo by Alfonso J. Rodriguez-Morales



Municipalities	Cases	Population*	Rates**	%	1 case:pop
San Juan de Nepomuceno	4565	32,514	14040.11	14.04	7
San Jacinto	2789	28,505	9784.25	9.78	10
Turbaco	6419	86,410	7428.54	7.43	13
Mahates	1134	25,464	4453.35	4.45	22
Cartagena	12237	955,250	1281.03	1.28	78
Arroyohondo	99	9,782	1012.06	1.01	99
El Carmen de Bolívar	614	74,297	826.41	0.83	121
Arjona	188	71,180	264.12	0.26	379

Incidence rate estimations for high CHIKV infection incidence municipalities in the north coast Caribbean region of Colombia, 2014. (*Official estimates, **Cases/100,000 pop.)

America and the Caribbean, excepting Cuba and Peru (which reported imported cases) as well as in non-tropical countries such as the United States of America (USA), Canada, Chile and Argentina (PAHO, 2015). However, in the USA, autochthonous cases in Florida have been reported.

Like dengue fever, climate influences the emergence and intensity of CHIKV (Campbell et al, 2015; Fischer et al, 2013; Quintero-Herrera et al, 2015; Zambrano et al, 2012; Herrera-Martinez & Rodríguez-Morales, 2010). In general, there is a growing consensus that infectious diseases transmitted via vectors are especially affected by climate change, which influences the latitudinal and altitudinal extent of distributions (Fischer et al, 2013; Semenza et al, 2012). To best prepare public health systems, a comprehensive CHIKV risk assessment that includes climatic risk zones and potential introduction gateways should be expanded to include societal and demographic drivers (Fischer et al, 2013; Semenza & Menne, 2009; ECDC, 2010).

As the incidence of CHIKV continues to increase, several factors need further attention. Although uncommon, coinfection between DENV and CHIKV is an emerging threat that requires more accurate diagnosis (Parreira et al, 2014). Vector surveillance is needed in most areas (Agudelo-Ospina et al, 2014), as well as primary prevention of disease, including community participation in health promotion and disease prevention, particularly in DENV and now CHIKV endemic areas of the Americas.

Another aspect to consider is related to travel. As the importation of DENV and CHIKV in North America and Europe is increasing proportional to the worldwide spread of these viruses (Tomasello & Schlagenhauf, 2013), prevention and management in travelers is also another important aspect related to the current ecoepidemiological scenario of both viral diseases in the Americas. For example Cartagena de Indias in Colombia is one of the major tourism sites on the Caribbean coast of South America. During 2014 incidence rates reached >1,000 cases/100,000 pop., representing a risk for travelers. Finally, in endemic and emerging zones, where CHIKV was not previously known, surveillance is needed and health care workers must be adequately trained to diagnose and treat the infection (Bedoya-Arias et al, 2015).

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Excerpts from "Progress and Challenges in Controlling Neglected Zoonotic Diseases," Published in Veterinary Record on 24 January, 2015

Suzanne Jarvis, Managing Editor, Veterinary Record and In Practice

Abstract: *Suzanne Jarvis reports from the Fourth International Meeting on the Control of Neglected Zoonotic Diseases, hosted by the World Health Organization in Geneva in November. The meeting looked at progress that has been made in controlling these diseases and at what the next steps should be for further control.*

"While progress has been made on controlling 'neglected' zoonotic diseases, if further inroads are to be made there is a need for greater political commitment, sustainable One Health collaborations and the participation of communities in control programmes. This was among the conclusions reached at the meeting, which took the theme 'From advocacy to action'.

"Dirk Engels, of the World Health Organization (WHO), explained the context of neglected zoonotic diseases within the framework for neglected tropical diseases that had been identified by the WHO. In May 2013, the World Health Assembly had adopted a WHO resolution and roadmap to accelerate work to control 17 identified neglected tropical diseases (www.who.int/neglected_diseases/WHA_66_seventh_day_resolution_adopted/en/); of these, seven were zoonotic diseases, including rabies, cysticercosis, echinococcosis, foodborne trematode infections and leishmaniasis. Good progress had been made with four of these diseases, said Dr Engels, so it was time for a rethink on the three others, namely rabies, cysticercosis and echinococcosis. The WHO, together with the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE), would now focus on controlling these three diseases. The countries that would benefit from action, and the point where disease transmission could be interrupted, had been identified and, said Dr Engels, the 'time is right to take action'."

Please read the full report at the following toll-free links generously provided to One Health Newsletter readers by the Veterinary Record: Abstract, PDF, Full Text

Ebola and Other Baddies from Bats, Birds, and Hogs: ProMED Quarterly Review

Jack Woodall, PhD

This review covers selected reports posted on the ProMED-mail outbreak early warning website <www.promedmail.org> and e-mailed to more than 60,000 free subscribers during the months of January and February 2015.

The big three outbreaks of zoonotic viruses (transmissible from animals to humans) this past quarter have been the same as before: Ebola, MERS and animal-origin influenza.

Ebola (Ebola Virus Disease, EVD), West Africa

The numbers of cases fell off precipitously at the end of 2014, leaving many beds empty in Ebola Treatment Centers and giving rise to false hopes that the epidemic was under control. But case numbers have rebounded to some extent this year, especially in the capital cities of Liberia and Sierra Leone, and considerable resistance remains to performing safe burials and carrying out the basic sanitary measures needed to stop transmission. There are continued episodes of violence against health workers.

Electron microscopy image of Ebola virus
Image from U.S. Centers for Disease Control & Prevention

The index case was allegedly traced back to a two-year-old child who had played with a bat in a remote forested region of Guinea. Some African bat species have been found in the laboratory to survive Ebola infection. Since most bats are rather small for an adult meal, they are routinely given to children in West Africa to barbecue and eat.

The first field trials of two candidate Ebola vaccines began in Liberia on 2 February. Neither contains the whole virus, but rather antigenic proteins from the virus: ChAd3 produced by GlaxoSmithKline, uses a chimpanzee adenovirus as a carrier, the other, by NewLink Genetics, uses vesicular stomatitis, a livestock virus. Neither virus causes human disease but they do infect and multiply in vaccinees. The Japanese drug favipiravir has been shown to increase survival in patients with a low ebolavirus load in West Africa. Trials of more vaccines and drugs are in the works, but a trial of the US drug brincidofovir in Liberia has been scrapped for lack of enough cases to test it on.

Middle East Respiratory Syndrome (MERS), Arabia

The virus is a beta-coronavirus more closely related to bat than other human coronaviruses. It has been isolated from one species of bat, but if bats are the reservoir host, nobody can explain how it gets into camels or people.

After a lull in the middle of last year, MERS infections returned with the season for camel births, but no consistent link to contact with camels or their milk or urine (taken for medicinal purposes) has been proven. A study of 1,000 camels in Dubai found that 95% of adult camels and 80% of camels less than a year old had antibodies. According to an official, most of the current spread of disease is happening in hospital settings.

WHO says more than 1,000 confirmed cases — including more than 400 deaths — have been reported in 23 countries since MERS emerged in 2012, with about 85% of them in Saudi Arabia. That's a case fatality rate of 40%; however, many of the fatal cases suffered from a wide range of concurrent health problems which may have weakened their immune systems.

Bird and swine flu, worldwide

Illustration by Ollie Crafoord of Stockholm, Sweden, CC-BY-2.0

Avian influenza has been throwing up new mutants. **H5N8** has shown the ability to travel well, having already shown up in poultry in Europe, North America, and Asia, but so far it does not appear to infect humans. **H5N6** & **H10N8** have only made a few appearances, but have infected and killed a handful of people. **H7N9** & **H9N2** are new mutants that have been detected during the quarter.

H3N2 was incorporated into the seasonal human flu vaccine for the Northern Hemisphere last year, which has been less than 50% effective. India is anomalous this year in reporting more H1N1 infections than H3N2 (see below).

H1N1, the so-called "swine flu", has caused over 10,000 cases and close to 700 deaths in India this quarter, and suspected H1N1 cases appeared across the border in Nepal at the end of February.

H5N1 has continued to cause the culling of thousands, if not millions of poultry around Eurasia and has now reached North America. It was confirmed in a hobby poultry flock for the first time in Canada (British Columbia) in February, after it was found in wild birds in neighboring USA (Washington State) in January. Satellite tracking has shown that a species of shorebird, the bar-tiled godwit, migrates annually from New Zealand via China to its breeding grounds in Alaska, so could have carried the virus from Asia to North America.

H7N9: 602 human cases of this strain of avian influenza (25% of them in this quarter alone), 227 fatal, have been reported in mainland China since the first human cases were recorded there in 2013. This is a 37% fatality rate, but the real case fatality rate is likely far lower, as only the very sickest individuals are likely to be hospitalized and tested.

H9N2: On 10 Feb 2015, the first human case of A (H9N2) influenza was detected in a 3-year-old boy by the routine national avian influenza surveillance system in Aswan Governorate, Egypt. The virus is endemic in Egyptian poultry. Will it cause a new human epidemic?

Yellow Fever

Yellow fever (YF) is a hemorrhagic fever that kills many more people every year in Africa than Ebola (the 2013 estimate is 78,000 – and there is an effective vaccine!). Its reservoir is in forest monkeys, transmitted by mosquitoes to people working in or visiting forested areas of tropical Africa and South America. It is easily prevented by taking a single dose of vaccine valid lifelong (but not recommended for infants less than 9 months old or adults aged more than 60). In January, WHO declared Zambia, in south-central Africa, a YF-free zone, to the delight of tour operators and the government. During the quarter, two unvaccinated Brazilian men caught YF in forest in the state of Goais; one of them died and the other was hospitalized in the city of Rio in February just before the huge influx of unvaccinated tourists for the Carnival parades. Fortunately, although that city is full of the yellow fever mosquito actively transmitting dengue, there was no spread.

Livestock diseases

African swine fever continues its inexorable spread in Europe, carried by wild boar which do not respect frontiers. Outbreaks this quarter were reported from

Estonia, Latvia, Lithuania and Russia. Cuba reported suspected **swine flu** in a piggery with the unfortunate name of "Pigs in Paradise" in February. A second case of apparently classical **mad cow disease (BSE)** was detected in Canada; the cow was excluded from the food chain. This should not affect Canada`s beef exports.

Pigs in Paradise, Bahamas
Image cropped from cdorobek under CC by 2.0

The following outbreaks were reported to the World Animal Health Organization (also known by its French acronym OIE):

- Sheep and goat pox, Kazakhstan & Mongolia
- Equine herpesvirus, USA & first report from Egypt;
- Equine vesicular stomatitis, USA
- Equine infectious anemia, USA & Germany
- Rare case of equine glanders, Germany
- Riding stable deaths of horses from a toxic antibiotic in the feed, USA

Wildlife diseases

ProMED reported multiple wildlife **die-offs** in the past quarter:

- 129 bluefin tuna and bonito in an aquarium in Tokyo, Japan, undiagnosed
- Oysters in North America (Pacific NW) due to ocean acidification
- 3,000 harbour seals in the sea off Denmark and Sweden, suspected to be caused by avian influenza **H10N7.**

A six-year-old Orangutan has died in a Florida zoo after eating invasive African snails carrying the parasite *Angiostrongylus cantonensis*, but no human cases have been reported – you`d have to eat them raw. Frogs in Madagascar and snakes in the USA are dying from fungal diseases. Also, in Rio de Janeiro, Brazil, thousands of fish carcasses were found in February floating in waters where sailing events are to be held during the 2016 Olympics, killed by sewage pollution.

As of mid-January over 1,200 wild birds originating from western US states -- the majority from Washington state – have been tested for **avian influenza** viruses by an initial molecular screening test (matrix RT-PCR). A total of 167 swabs (14%) were positive and seven HPAI (highly pathogenic avian influenza) intercontinental group A strains of **H5N1**, **H5N2**, and **H5N8** were found. The new intercontinental group A (**icA**), has been proposed to differentiate this growing group of H5-reassortant viruses that originated in Asia from other viruses such as the Asian H5N1 HPAI. The novel **icA H5N1** HPAI virus recently detected in Washington is different from the Asian strain of H5N1 HPAI. It is a reassortant, or mixed-origin, virus that incorporates Asian-origin genes together with other genes from a low-pathogenic avian influenza virus of North American wild-bird origin. There has been no evidence for

Harbor Seal. *Image from Wiki Commons*

icA H5 virus-related illness in humans, but appropriate hygiene measures should be observed when handling wild birds.

Crop diseases

Diseases that reduce the yield of food and livestock feed crops can have a drastic effect not only on human nutrition but also on the pockets of small farmers, which is why ProMED continues to monitor them.

Agricultural unions in Spain are demanding urgent action following the discovery of a vector for Huanglongbing, one of the most damaging citrus plant diseases in the world. The detection of the African psyllid (jumping plant louse) marks the first time the insect has been spotted in mainland Europe, leading to fears it could cause irreversible damage to the country's citrus exports.

This quarter there were first reports of Asian leaf rust in soybeans in Malawi & Costa Rica, and lettuce big-vein disease (LBVD) in Saudi Arabia. LBVD can seriously reduce yield and quality of the crop. Other first reports include:

- Brown rot, potatoes, Poland
- Ring rot, potatoes, Hungary
- Lethal necrosis, maize, Ethiopia
- Verticillium wilt, oilseed rape, Canada (there was an alert for light leaf spot, also on oilseed rape, in the UK);
- Pinot gris virus, grapevines, Czech & Slovak Republics
- Flavescence doree, grapevines, Germany
- Fireblight, pear, Finland.

The disease resistant "Robin" wheat variety was struck by a new strain of stem rust in Kenya, where wheat is the second most important crop after maize. Undiagnosed diseases have broken out in rice in Peru & Philippines; potato & tomato in Nepal; and potato in India.

We are generally unaware of how many of our food crops are under attack by infectious diseases, for which the main recourse is breeding resistant varieties and distributing clean seed and plantings.

Psyllid. *Image from North Carolina State University*

Jack Woodall, PhD, is Co-founder and Associate Editor of ProMED-mail. He is also a member of the One Health Initiative team.

Advancements in One Health

UGA Researchers Develop New Treatment for Rabies

University of Georgia (Athens, Georgia, USA) researchers have been successful with a new method of treatment for rabies in mice, even after the virus has spread to the central nervous system. They're recent findings have been published in the Journal of Virology.

"Our team has developed a new vaccine that rescues mice much longer after infection than what was traditionally thought possible."

Advancements (continued)

Rabies virus is usually fatal once physical symptoms have developed. "However, 50 percent of mice treated with the new vaccine were saved, even after the onset of physical symptoms on day six."

Summarized from: http://news.uga.edu/releases/article/beating-the-clock- researchers-develop-new-rabies-treatment-0115/

One Health Master Class

GIPA
In hoc signo vinces

Logo of the Georgian Institute of Public Affairs

On December 24, 2014 the Georgian Institute of Public Affairs (GIPA) with the support of the Laboratory of the Ministry of Agriculture (LMA), US Center for Disease Control and Prevention (CDC) and Colorado State University (CSU) organized a one-day master class on One Health related issues. The meeting was held at the Tbilisi Courtyard Marriott Hotel.

The master class was opened by Maka Ioseliani, GIPA Rector; Levan Davitashvili, Deputy Minister of Agriculture; Maia Bitadze, Deputy Minister of Environment and Natural Resources Protection, and Archil Talakvadze, Deputy Minister of Internal Affairs. The master class was lead by Lali Madzgharashvili, Head of the LMA, and Kendra Stauffer, US CDC representative in Georgia and One Health Team Leader. Representatives of the Ministry of Labor, Health and Social Affairs, Ministry of Agriculture, Ministry of Environment and Natural Resources Protection and Ministry of Internal Affairs comprised the participants of the master class.

Nana Kashakashvili, Head of the Georgian Rural Development Department of GIPA, awarded certificates of participation to all those in attendance.

GIPA has expressed its intent to actively work towards the development of the One Health process along with offering different educational opportunities to interested parties.

For more information please contact: Taka Zhgenti (Georgian Rural Development Department, Georgian Institute of Public Affairs – GIPA) by email: t.zhgenti@gipa.ge

One Health Master Class.
Photos courtesy of Georgian Institute of Public Affairs

Advancements (continued)

Food and Drug Administration tackles antimicrobial resistance with new directives

With the collaboration of Health and Human Services and the Department of Agriculture, a Veterinary Feed Directive has been established to limit the use of medical feed additives that are deemed appropriate and necessary under the oversight of a veterinarian. More information for veterinarians, feed distributors, and producers can be found here.

The Food Safety Inspection Service in the Department of Agriculture has made additional progress to combat antimicrobial resistance and food-borne illnesses through updated directives on foodborne pathogen detection, the National Antimicrobial Resistance Monitoring System, and the understanding of foreign food safety systems.

With these and other directives, the USDA FSIS, HHS, and FDA will be taking action to monitor national antimicrobial resistance, international food safety, and agricultural security. More information can be found at the FSIS website: http://www.fsis.usda.gov/wps/portal/fsis/home

Senators send One Health Letter Endorsement to the U.S. President

[Originally printed on the One Health Initiative website]

Seven United States Senators, led by Minnesota's U.S. Senator Al Franken, sent a One Health Endorsement Letter to U.S. President Barack Obama.

"As you address current and future zoonotic diseases—human diseases with animal origins—we write to urge you to pursue a multidisciplinary, multisectoral approach that encompasses both human health expertise, and animal and environmental health disciplines"

Note: The One Health concept/approach is a non-partisan international public health/clinical comparative medicine health issue.

Please read the entire letter at:
http://www.onehealthinitiative.com/publications/15%202%2012%20Letter%20to%20POTUS%20-%20One%20Health.pdf

Florida Keys Mosquito Control Project- Genetically Engineered Mosquitoes

The Florida Keys Mosquito Control District (FKMCD) is exploring innovative ways to reduce the *Aedes aegypti* mosquito population in the Florida

Keys while limiting potential environmental consequences that come with traditional techniques such as chemical larvicides and adulticides. Aedes aegypti mosquitoes are non-native to the United States and can spread diseases such as dengue fever and chikungunya. A proposed solution to reduce the *Aedes aegypti* population involves the FKMCD working with Oxitec scientists to release genetically engineered male Aedes aegypti mosquitoes. Male mosquitoes do not bite or transmit disease. The engineered mosquitoes only mate with wild *Aedes aegypti* females, and due to the genetic engineering of the released males (based on the Sterile Insect Technique), over 95% of offspring from these matches will not live to adulthood. This solution has been successfully tested in the Cayman Islands and Brazil with *Aedes aegypti* populations being reduced by over 90%. Michael S. Doyle, Director of FKMCD, states, "As the Director of FKMCD, I am always looking for more effective ways to keep our mosquito population down to an acceptable level. Based on results thus far, the tool developed by Oxitec is very promising against a very difficult mosquito."

Female *Aedes aegypti* mosquito feeding
Photo from US CDC

No mosquitoes will be released until the FDA and other partner agencies have evaluated the project.

For more information about current Florida Keys mosquito control efforts, please visit: http://keysmosquito.org/programs-domestic-field-ent-services-offshore-trucks-aerial/

For information about the genetically engineered mosquitoes, please visit: http://www.oxitec.com/health/florida-keys-project/,
and see this informational flyer:
http://www.oxitec.com/wpcms/wp-content/uploads/Oxitec-FKMCD-mosquito-control-project-flyer-Oct2014.pdf

Upcoming Events

One Health: Integrating the Veterinarian Scientist into the Biomedical Research Enterprise
NIH, Bethesda, MD
April 7-8, 2015
http://www.scgcorp.com/ORIPOneHealth2015/

7th International Conference on Climate: Impacts and Responses
Vancouver, Canada
April 10-11, 2015
http://on-climate.com/the-conference

National Foundation for Infectious Diseases (NFID) 18th Annual Conference on Vaccine Research (ACVR)
Bethesda, MD
April 13-15, 2015
http://www.cvent.com/events/18th-annual-conference-on-vaccine-research/event-summary-3c5831a03ce8408f8c236f79ad11332f.aspx?refid=oc

Zoobiquity Boston Conference
Boston, MA
April 25, 2015
http://zoobiquity.com/2015-zoobiquity-conference/

25th Annual Molecular Parasitology/Vector Biology Symposium
UGA Hotel and Conference Center, Athens, GA
April 28-29, 2015
http://ctegd.uga.edu/events/symposium/

World Veterinary Association and World Medical Association Global Conference on One Health
Madrid, Spain
May 21-22, 2015
http://www.wma.net/en/50events/20otherevents/80onehealth/index.html

64th Annual Wildlife Disease Association Conference
Novotel Twin Waters Resort, Queensland, Australia
July 26-30, 2015
http://www.wda2015.org

American Society of Microbiology International Conference on Emerging Infectious Diseases
Hyatt Regency, Atlanta, GA
August 24-26, 2015
http://www.iceid.org

32nd World Veterinary Congress
Istanbul, Turkey
September 13-17, 2015
http://www.wvcistanbul2015.com

64th Annual American Society of Tropical Medicine & Hygiene Meeting
Philadelphia, PA
October 25-29, 2015
http://www.astmh.org/Home.htm

Recent Publications in One Health

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New One Health Book Publication

One Health: the theory and practice of integrated health approaches. Edited by J. Zinsstag, E. Schelling, M. Whittaker, M. Tanner, D. Waltner-Toews. CABI, 2015. 480 pages. ISBN 978-1-780-64341-0. Price $216

Available from http://www.cabi.org/bookshop/book/9781780643410

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Call for "One Health" Manuscripts

Infection Ecology & Epidemiology: The One Health Journal
This open access journal features original research articles, review articles, or other scientific contributions in One Health, that motivate interdisciplinary collaborations between researchers in various clinical and environmental health disciplines.
http://www.infectionecologyandepidemiology.net/index.php/iee

Veterinary Sciences
This open access journal supports original scientific research, review articles and short communications that promote theoretical and experimental studies in the veterinary sciences and improve understanding of "One Medicine" and "One Health".
http://www.mdpi.com/journal/vetsci

One Health
This new open access journal supports multi-disciplinary research collaborations that focus on the One Health platform, in order to provide rapid dissemination of scientific findings related to zoonotic pathogens, as well as their inter- and subsequent intra-species transmission.
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