One Health: Emerging Diseases and Opportunities for Collaboration

Emily S. Bailey, PhD
Duke University

Characteristics of a "Wicked Problem"

- Difficult to clearly define
- Many interdependencies and often multicausal
- Attempts to address the problem often lead to unforeseen consequences
- Frequently not stable
- Usually no clear solution
- Socially complex
- Rarely is the responsibility of only one stakeholder
- Solutions involve changing behaviors
- Can be characterized by chronic policy failure

From PDA letter May 4, 2016

Wicked Infectious Disease Problems

- Food security/safety
- Antimicrobial resistance (AMR)
- Emerging infectious diseases

While unique I argue that these are interrelated

Foodborne Illnesses

The Centers for Disease Control and Prevention (CDC) estimates that each year in the USA foodborne illnesses cause:

- 1 in 6 (48 million) Americans to become sick
- 128,000 to be hospitalized
- 3000 persons to die

https://www.medscape.com/features/slideshow/foodborne-illness-outbreaks#page=10

The Well-Traveled Salad.

Do You Know Where Your Food Has Been?

As consumers, many of us fail to recognize that even our domestic and local food supplies are part of a global network. The daily activity of consuming food directly links our health as humans to the health of crops and produce, food animals, and the environments in which they are produced.

LETTUCE
Canada, Chile, Dominican Republic, Mexico, Peru, USA

CUCUMBERS
Canada, Honduras, India, Mexico, Spain, USA

FETA CHEESE
Canada, Denmark, Egypt, Germany, Greece, Israel, Italy, Turkey, UK, USA

VINAIGRETTE
Argentina, Brazil, Canada, Chile, China, France, Germany, Greece, India, Indonesia, Italy, Mexico, Morocco, Peru, Portugal, Spain, Thailand, Tunisia, Turkey, USA, Vietnam

OLIVES
Greece, Israel, Mexico, Spain, USA

SPROUTS
Argentina, Australia, Bangladesh, Canada, China, Egypt, France, India, Morocco, Nepal, Pakistan, South Africa, Spain, Turkey, USA

MANDARIN ORANGES
Israel, Mexico, Morocco, South Africa, Spain

ONIONS
Canada, China, Germany, India, USA

TOMATOES
Canada, Dominican Republic, Holland, Israel, Italy, Mexico, USA

CROUTONS
Argentina, Australia, Brazil, Canada, China, France, India, Mexico, Netherlands, Poland, Russia, Switzerland, Uruguay, USA, Vietnam

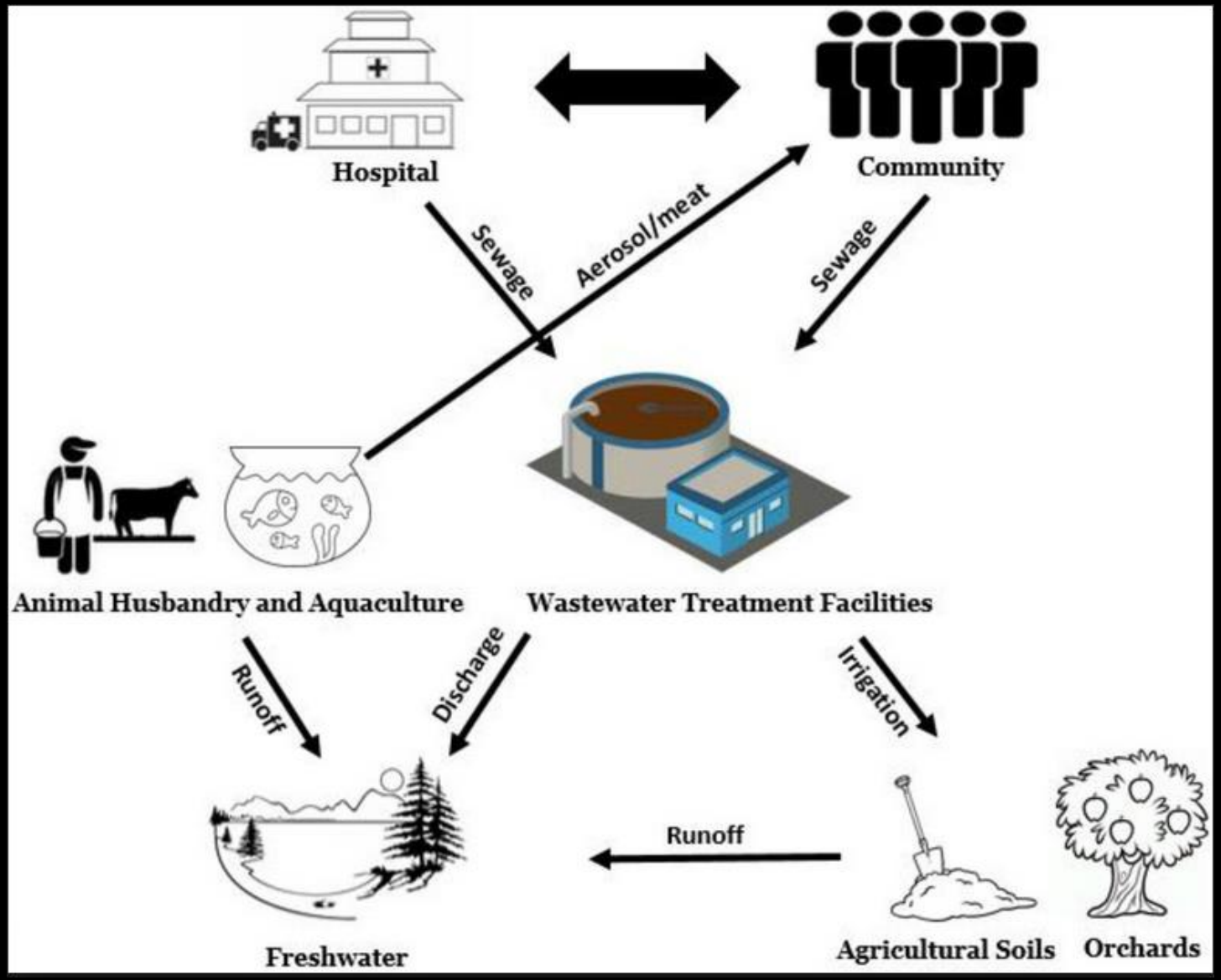
A "One Health" approach to food safety—bringing together expertise and resources from the clinical, veterinary, wildlife health, and ecology communities—has the potential to reveal the sources, pathways, and factors driving the outbreaks of foodborne illness and possibly prevent them from occurring in the first place.

NOTE: Countries are listed in alphabetical order and not by volume of export.

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

www.iom.edu

Selection of AMR pathogens



From http://essays.biochemistry.org/content/61/1/11

How Drug-Resistant Bacteria Travel from the Farm to Your Table

Antibiotic-resistant bacteria from livestock pose a deadly risk to people. But the farm lobby won't let scientists track the danger

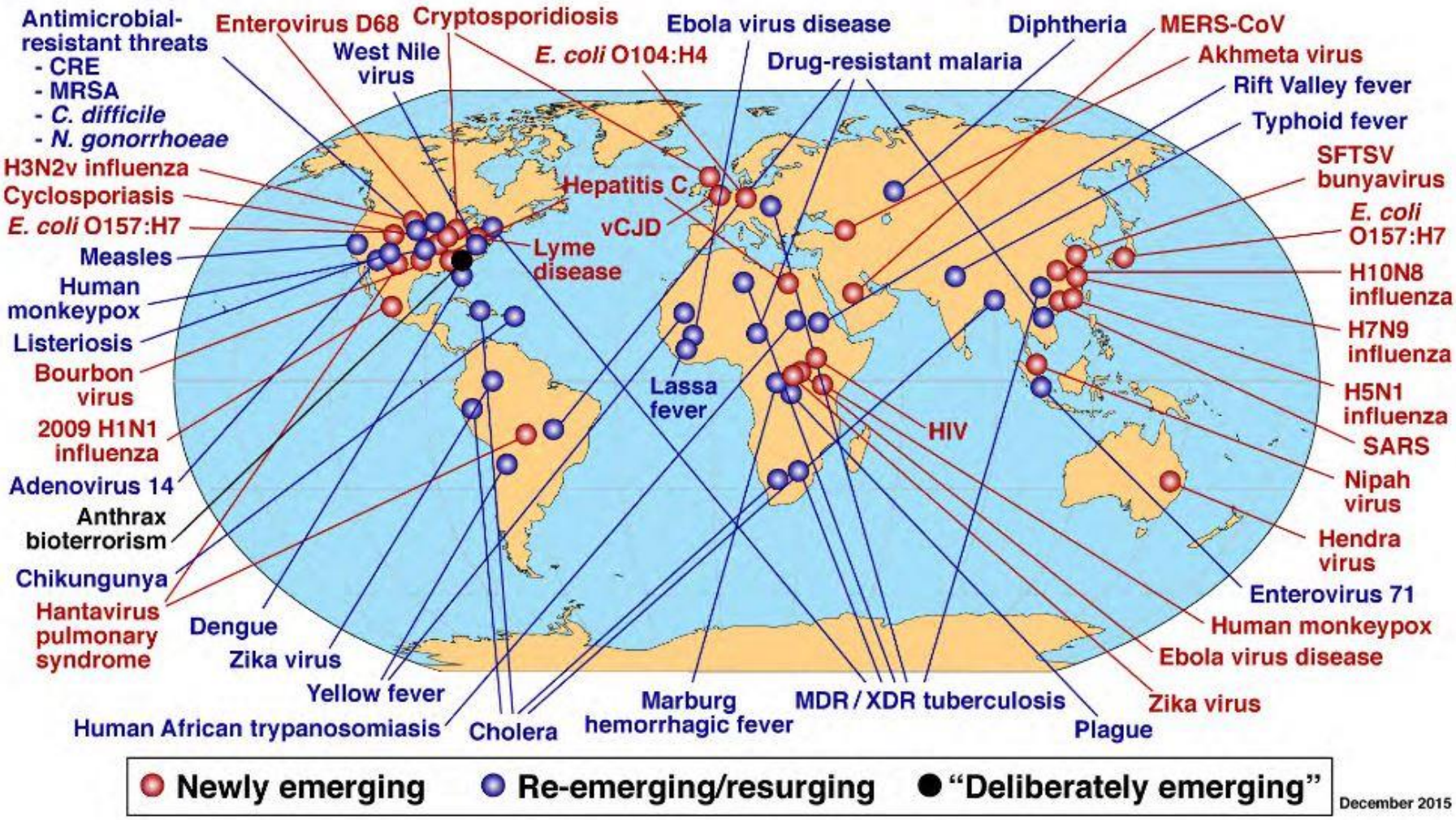
By Melinda Wenner Moyer on December 1, 2016

READ THIS NEXT

The Enemy within: A New Pattern of Antibiotic Resistance

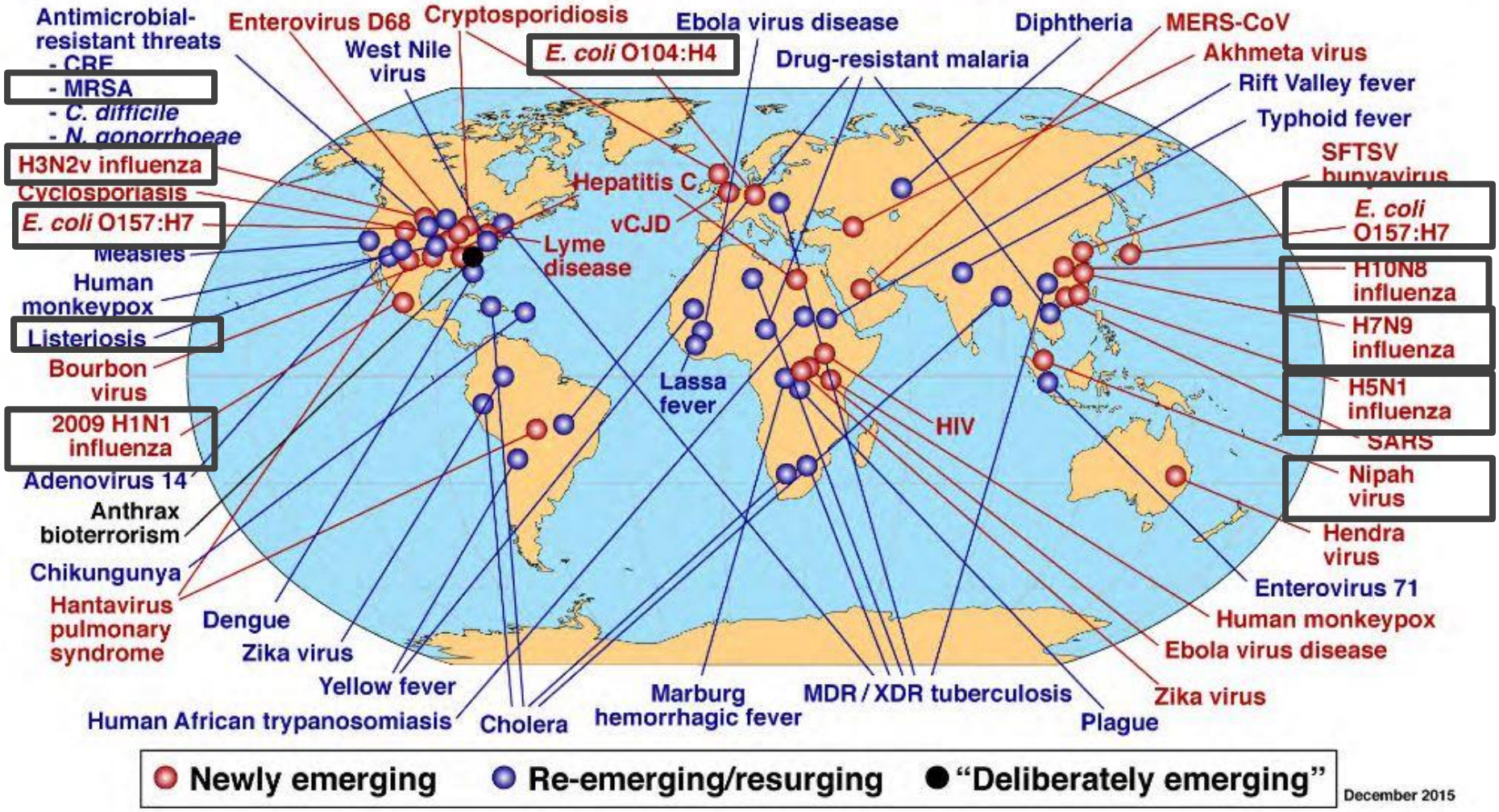
Curb Antibiotic Use in Farm Animals

Global Examples of Emerging and Re-Emerging Infectious Diseases



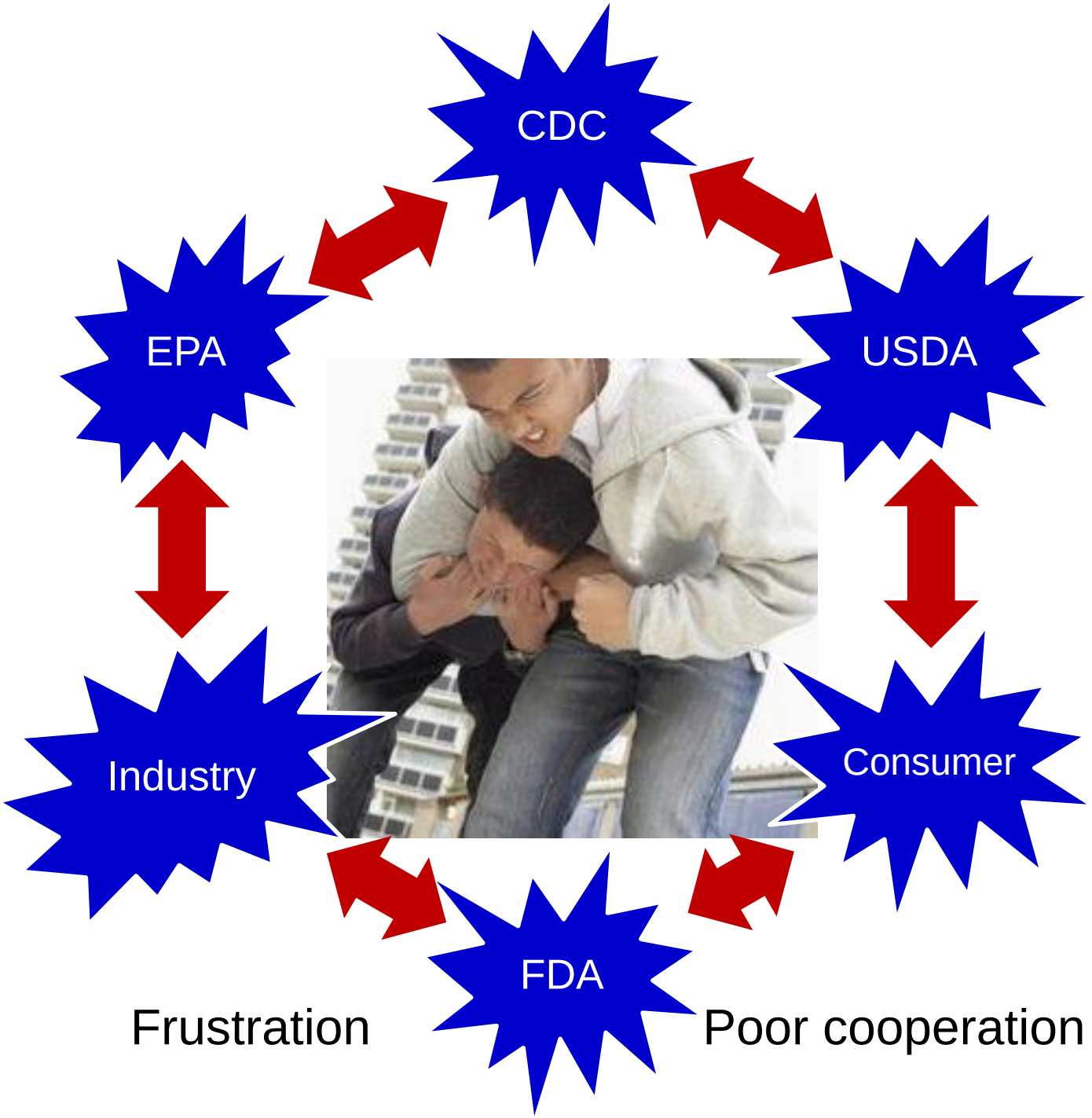
Source: Anthony S. Fauci, NIAID (2015)

Global Examples of Emerging and Re-Emerging Infectious Diseases



Source: Anthony S. Fauci, NIAID (2015)

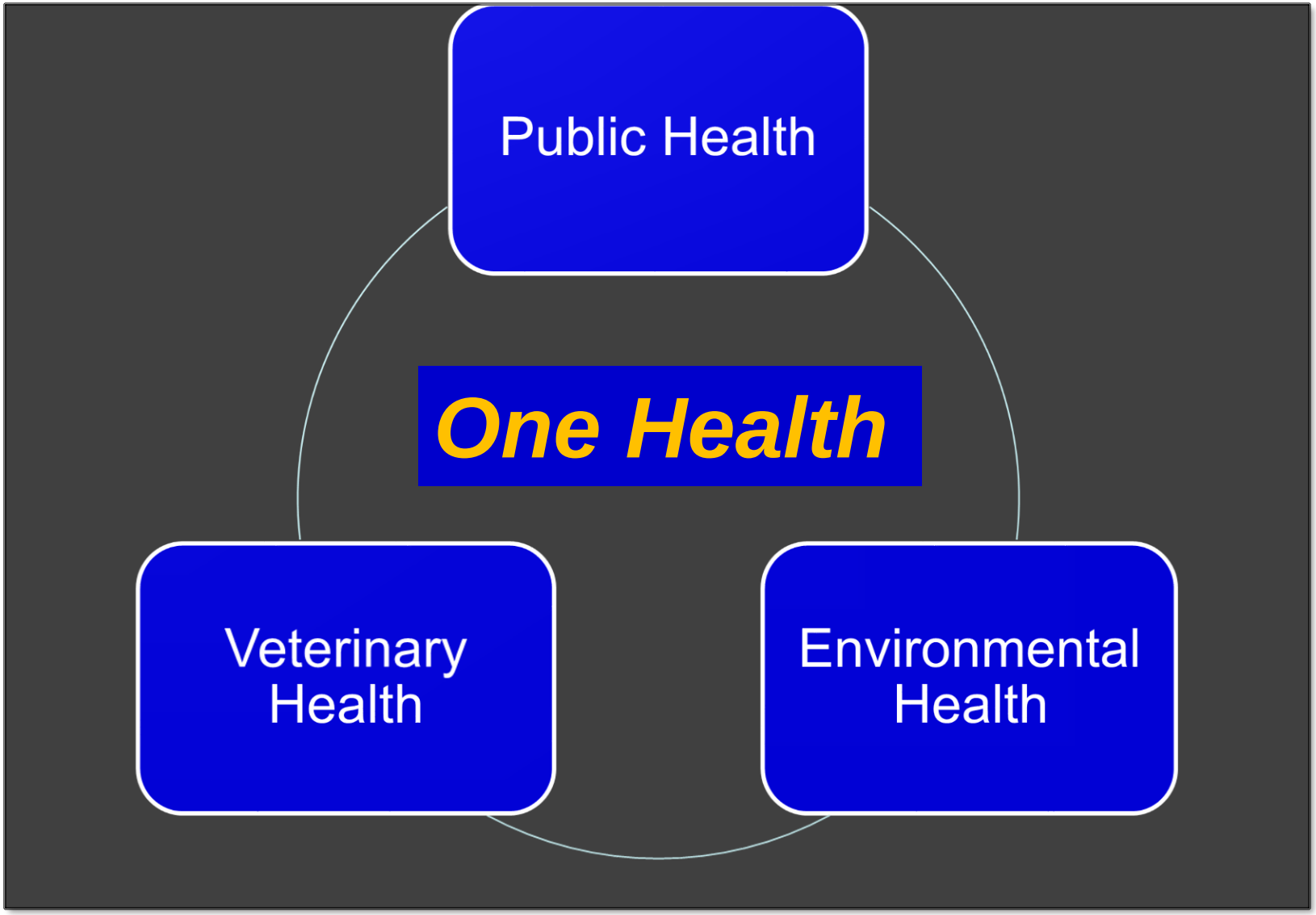
- No one discipline is trained to engage such wicked infectious disease problems
- No one agency or organization can control such wicked infectious disease


CDC
EPA
USDA
Industry
Consumer
FDA
Frustration
Poor cooperation

One Health Defined

"One Health is the collaborative effort
of multiple disciplines
- working locally, nationally, and globally -
to attain optimal health
for people, animals, and our environment."

AVMA One Health Initiative Task Force 2008



A One Health approach gains cooperation from all parties involved and employs public health, veterinary health, and environmental health approaches to bring balance to solving difficult public health problems

97 organizations that have endorsed the One Health Initiative as of March 2018

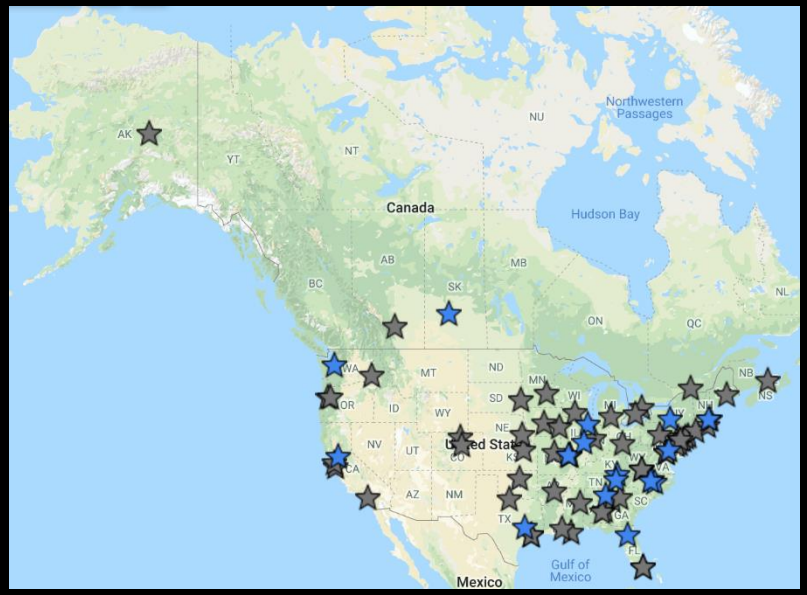
SIAARTI Study Group in Animal Anesthesia Naples, Italy
Agronomes et Vétérinaires Sans Frontières
American Academy of Family Physicians
American Academy of Pediatrics
American Association of Public Health Physicians
American Association of Veterinary Laboratory Diagnosticians
American Association of Wildlife Veterinarians
American College of Preventive Medicine
American College of Veterinary Microbiologists
American College of Veterinary Pathologists
American College of Veterinary Preventive Medicine
American Medical Association
American Meteorological Society
American Mosquito Control Association
American Nurses Association
American Physiological Society
American Phytopathological Society
American Society for Microbiology
American Society of Tropical Medicine and Hygiene
American Veterinary Medical Association
Animal Medical Center, New York, USA
Animal/Human Health for Environment and Development for Great Limpopo Transfrontier Conservation Area
ANIMALS 24-7
Association of Academic Health Centers
Association of American Medical Colleges
Association of American Veterinary Medical Colleges
Association of Schools of Public Health
Auburn University's College of Veterinary Medicine, Auburn, Alabama, USA
Bella Moss Foundation, United Kingdom
Biomedical Technology, Epidemiology and Food Safety Global Network: Brno, Czech Republic
CAB International
Center for One Health Research - University of Washington, USA
CGIAR Research Program – Agriculture for Nutrition and Health
Colegio de Médicos Veterinarios de PR
College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, USA
Conservation through Public Health
Corporation Red SPVet, Bogota-Columbia
Council for Agricultural Science and Technology
Council of State and Territorial Epidemiologists
Croatian Society for Infectious Diseases
Department of Molecular and Comparative Pathobiology, Johns Hopkins University School of Medicine
Exuberant Animal
Faculty of Veterinary Medicine at the Universidad Autonoma de Nuevo Leon, Mexico
Federation of European Microbiological Societies
Federation of Veterinarians of Europe
Global Alliance for Rabies Control
Horizon International, Yale University
Immune Macro Biotic Technology, UK
Immuno Valley Consortium in The Netherlands
Indian Veterinary Public Health Association
Infection Prevention and Control, Canada
Institute of Tropical Medicine, Department of Animal Health, Antwerp, Belgium
Interacademy Medical Panel
International Association of Risk Management in Medicine
International Federation of Ageing
International Journal of One Health, India
International Livestock Research Institute
Italian Society of Preventive Medicine
Kansas City Area Life Sciences Institute – Kansas City, MO, USA
National Academies of Practice
National Association of State Public Health Veterinarians
National Centre for Animal Health, Bhutan
National Environmental Health Association
National Forum of Comparative Medicine, Romanian Academy of Medical Sciences
National Park Service, USA
New Zealand Centre for Conservation Medicine, Auckland
Nigerian Biomedical and Life Scientists
Nigerian Veterinary Medical Association
One Health Commission, USA
One Health in Epidemiology, Massey University, New Zealand
One Health New Medical Concept Association in Romania
Ovarian Cancer Symptom Awareness, USA
Pak One Health Alliance
Pet Partners formerly Delta Society
Praecipio International
SAPUVET III Project
Silent Heroes Foundation
Society for Tropical Veterinary Medicine
South Africa Society of Travel Medicine
SpayFIRST, Inc.
State Environmental Health Directors
The National LINK Coalition
United States Animal Health Association
University of Girona, Catalonia, Spain, Institute of Aquatic Ecology, Oceans & Human Health
Urban Health and Climate Resilience Centre, Surat, India
Vermont Veterinary Medical Association
Vermont Veterinary Medical Association One Health Committee
Veterinarians without Borders/ Vétérinaires sans Frontières, Canada
Veterinarni Medicina, the international journal for biomedical and veterinary sciences
Veterinary Bioscience Institute
Vida Volunteer
WiLDCOAST/COSTASALVAjE
Wildlife Disease Association
World Association of Veterinary Laboratory Diagnosticians
World Medical Association
World Organization of Family Doctors
Zoonotic and Emerging Diseases, Edinburgh, UK

Interest in One Health is Spreading

Known academic One Health training, research, and outreach programs in North America

Aug 2016

26% increase



Sept 2018

Universities that offer formal One Health, academic credit-earning programs

Universities with non-academic credit-earning One Health programs or research

Stroud C, Kaplan B, Logan JE, Gray GC. One Health training, research, and outreach in North America. *Infection Ecology & Epidemiology*. **2016** Jan 1;6(1):33680.


One Health
initiative
Search
One Health Initiative will unite human and veterinary medicine
The One Health Initiative is a movement to forge co-equal, all inclusive collaborations between physicians, osteopathic physicians, veterinarians, dentists, nurses and other scientific-health and environmentally related disciplines, including the American Medical Association, American Veterinary Medical Association, American Academy of Pediatrics, American Nurses Association, American Association of Public Health Physicians, the American Society of Tropical Medicine and Hygiene, the Centers for
Emerging and Reemerging infections - 70% vector-borne or zoonotic
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Advisory Board (Hon.)
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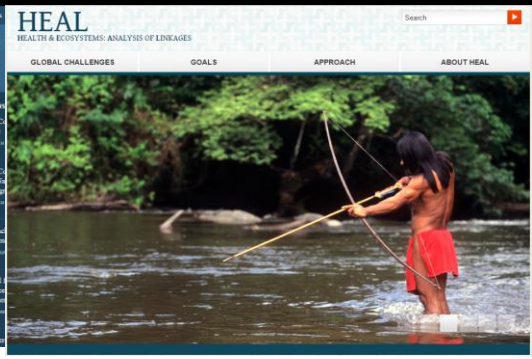
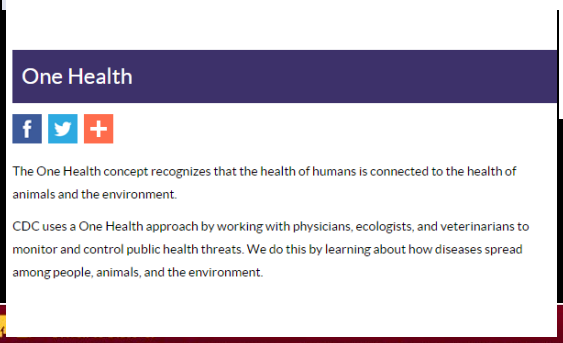
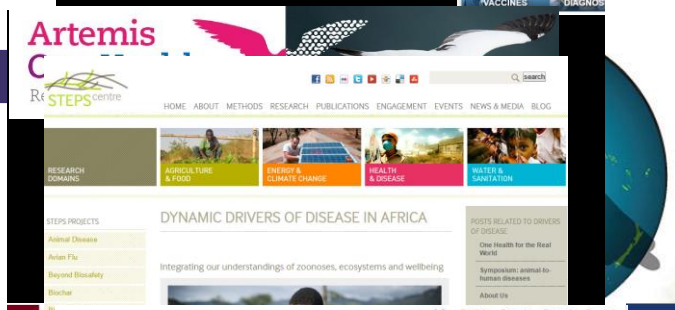
One Health in the News


INSTITUTE FOR INFECTIOUS ANIMAL DISEASES
60%
Making agriculture and public health more resilient through early detection, diagnosis, prevention, response, and recovery
VACCINES
DIAGNOS


HEAL
HEALTH & ECOSYSTEMS: ANALYSIS OF LINKAGES
GLOBAL CHALLENGES
GOALS
APPROACH
ABOUT HEAL


CDC
Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™


One Health
The One Health concept recognizes that the health of humans is connected to the health of animals and the environment.
CDC uses a One Health approach by working with physicians, ecologists, and veterinarians to monitor and control public health threats. We do this by learning about how diseases spread among people, animals, and the environment.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HEALTH & DISEASE
WATER & SANITATION
DYNAMIC DRIVERS OF DISEASE IN AFRICA
Integrating our understandings of zoonoses, ecosystems and wellbeing


One Health EcoHealth 2
4-7 December 2016 • Melbourne Convention & Exhibiti
The 4th International One Health Congress & 6th Biennial Congress of the International A


Whole Village Project
what's inside
Welcome to the Whole Village Project
The vision of the Whole Village project is to work with people in rural African communities and their development partners to acquire and use knowledge for improving long-term health and well-being while sustaining natural resources.
The Whole Village Project assists with the implementation of development-assistance projects in rural Tanzanian villages by determining whether particular development projects produce measurable changes in the lives of rural villagers and by identifying where and how development initiatives can be most effectively targeted.
related links
University Links
Global Programs and Strategy Alliance
Minnesota Population Center
Learning Abroad Center
College of Education & Human Development
Center on Global Health & Social Responsibility
Institute on the Environment
International Student & Scholar Services
External Links
INSTITUTE ON THE ENVIRONMENT
UNIVERSITY OF MINNESOTA
Driven to Discover℠
Since September 2009, data have been gathered from more than 56 villages in northern Tanzania. See map of villages visited to date below.


World Health Organization
Health topics
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About WHO
Food safety
Five Keys to safer aquaculture products to protect public health
With these new materials, WHO continues to promote safe food handling practices along the food chain - from farm to table. Developed in collaboration with the Food and Agriculture Organization of the United Nations (FAO), the " Five Keys to safer aquaculture products to protect public health" will support those who usually do not have access to formal education in food safety, such as women in rural areas, while they are playing an important role in producing food for their community.
Download Five Keys to safer aquaculture products to protect public health
Highlights
Five Keys to safer aquaculture products to protect public health
Launch of the "WHO estimates of the global burden of foodborne diseases"
World Health Day 2015: Food Safety


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ISID is committed to improving the care of patients with infectious diseases, the training of clinicians and researchers in infectious diseases and microbiology, and the control of infectious diseases around the world. > learn more
UPCOMING EVENTS
17th International Congress on Infectious Diseases
Hyderabad, India
What's New
Follow the new ISID Facebook page!
The Special Pre-Congress Edition of the ISID News is now available.
2015 BMA Medical Book Awards for book on Emerging infections - First Prize, Public Health


Animals Always®
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ANIMALS
CONSERVATION
EDUCATION
EVENTS
MEMBERSHIP
GIVE
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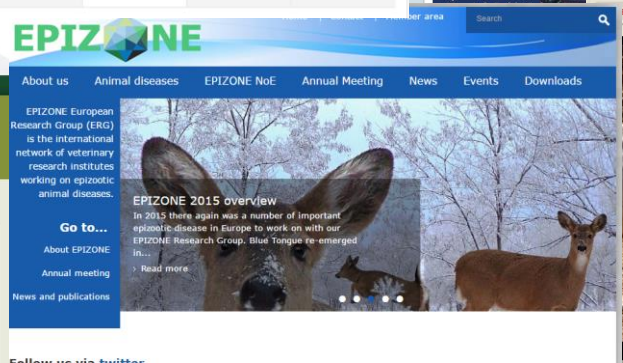
Box Turtle Project
Dromedary Camels Project
Galapagos Tortoise Project
Human Health Benefits Project
Water Quality in Missouri
Publications
One Health Fair (April 16)
Institute for Conservation Medicine
Veterinarians, ecologists and human medical professionals are recognizing the role of infectious disease as an increasing threat to the health of animals, humans and ecosystems. A number of these pathogens, including rabies and Ebola viruses, directly affect the health of wildlife and human populations. During this same time, conservation biologists and veterinarians became aware of the impacts of infectious and non-infectious diseases on the long-term survival of many wildlife species.
To address the challenges associated with the growing interconnections
"One Health" Fair
Saturday, April 16, 2016
9 a.m. to noon, Free
Learn about the links between wildlife conservation and human health from Zoo staff, St. Louis University and Washington University medical students, and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EPIZONE European Research Group (ERG) is the international network of veterinary research institutes working on epizootic animal diseases.
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In 2015 there again was a number of important epizootic disease in Europe to work on with our EPIZONE Research Group. Blue Tongue re-emerged in...
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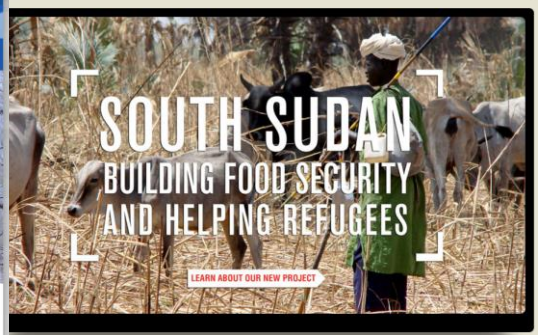
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VÉTÉRINAIRES SANS FRONTIÈRES
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One Health initiative

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- Amer Vet Epid Soc (AVES)
- Am Assn Pub H Physicians
- One Health Newsletter
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- ProMED Outbreak Reports
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- Supporter Endorsements
- Upcoming Events

One Health Initiative will unite human and veterinary medicine

The One Health Initiative is a movement to forge co-equal, all inclusive collaborations between physicians, osteopathic physicians, veterinarians, dentists, nurses and other scientific-health and environmentally related disciplines, including the American Medical Association, American Veterinary Medical Association, American Academy of Pediatrics, American Nurses Association, American Association of Public Health Physicians, the American Society of Tropical Medicine and Hygiene, the Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture (USDA), and the U.S. National Environmental Health Association (NEHA). Additionally, more than 900 prominent scientists, physicians and veterinarians worldwide have endorsed the initiative.

> more about one health

:: view large map ::

Please see MONOGRAPH in Veterinaria Italiana

"One Health - One Medicine": linking human, animal and environmental health

:: click here ::

HISTORY of the One Health Initiative team

(April 2006 through September 2015) and the One Health Initiative website since October 1, 2008

:: click here ::

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World Health Through Collaboration

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One Health

Linking Human, Animal, and Ecosystem Health

A Ravenswood Media Video Production

See 'What' we are doing to:

"CONNECT" - One Health Stakeholders to

"CREATE" - Strategic Networks/Teams/Partnerships that will

"EDUCATE" - About One Health and One Health issues.

What is One Health video

OH Public Service Announcement

OHC Letter to The White House

One Health Action Teams

One Health - 'A Ray of Hope' for the

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STUDENT Future Leaders in One Health LinkedIn Page

STUDENT Who's Who in One Health

One Health in the News

03/07/18 Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) meeting held in Atlanta

On March 7-8, a two-day Transatlantic...

02/21/18 First 'Global Flipped Classroom in One Health': From MOOCs to research on real world

One Health Hot Topics

**** HOT TOPICS ****

OHC Call to Action for Social Scientists

One Health Day 2017 sees over 110 Events in over 30 countries

OIE, FAO and WHO release their second One Health Tripartite document

INTERNATIONAL ONE HEALTH CONGRESS | ONE HEALTH DAY | SCIENTIFIC COLLOQUIUM

ONE HEALTH PLATFORM
it's all connected

Creating a healthy future for humans, animals and their environmen

What we do | Who we are | About One Health | Tools and activities | Calendar | Contact

Welcome to the One Health Platform web portal, the virtual meeting place for the fast growing One Health community.

One Health Media Bulletin

Follow the bulletin

Fellowship Fund

Due to the many Fellowship Fund applications received, the Review Committee members faced an impossible challenge to meet the original deadline of 15 January to announce their results.

→

one health DAY NOV

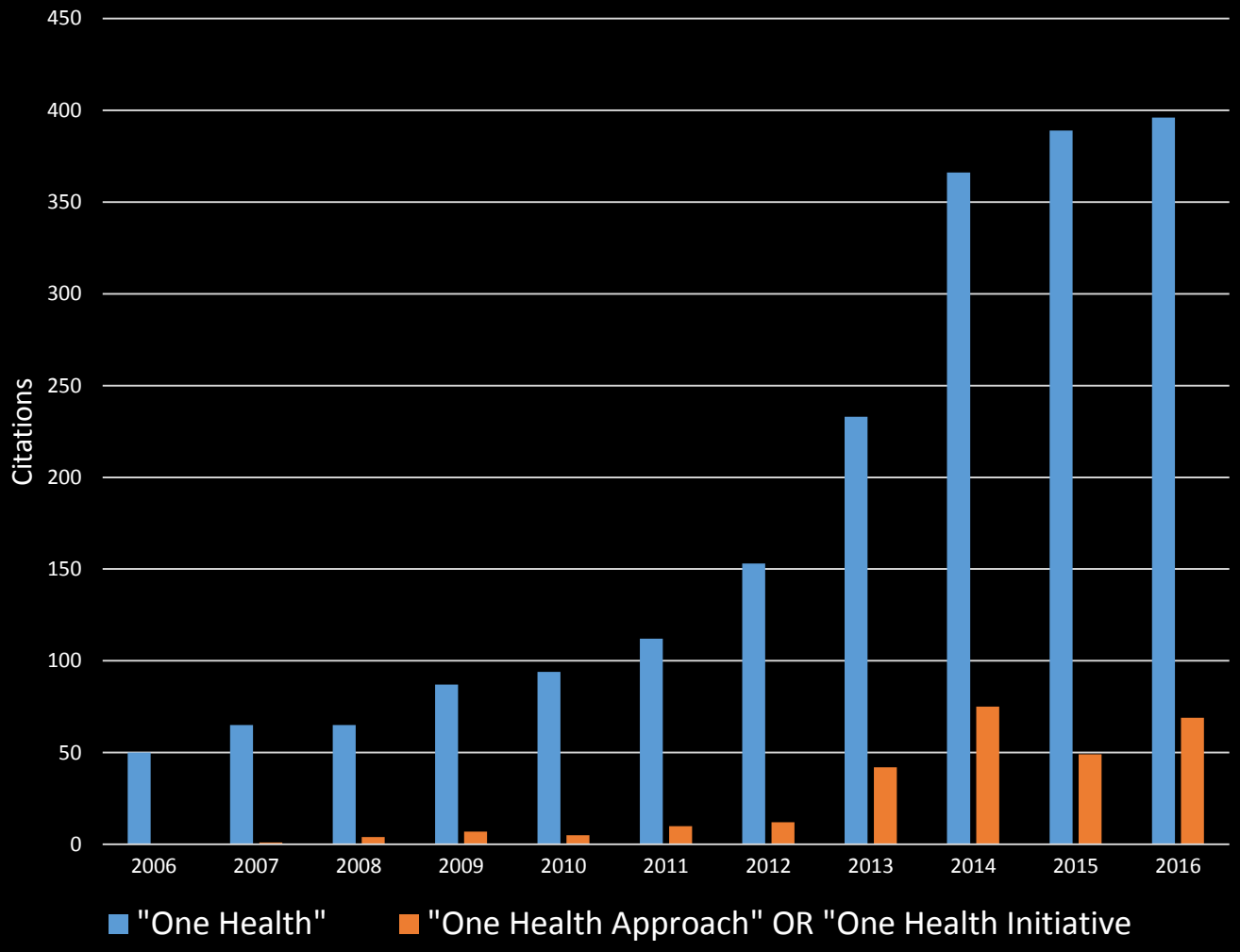
One Health Communicator

Periodically printed publication in newspaper format brings the latest news and information from the One Health arena

One Health Journal

An online-only, open access Journal in

One Health Research Publications



PUBMED search 4/24/2017 for ”One Health”, “One Health initiative” OR “One Health approach” in abstract or title by year

One Health Research Publications

PLOS | BIOLOGY

META-RESEARCH ARTICLE

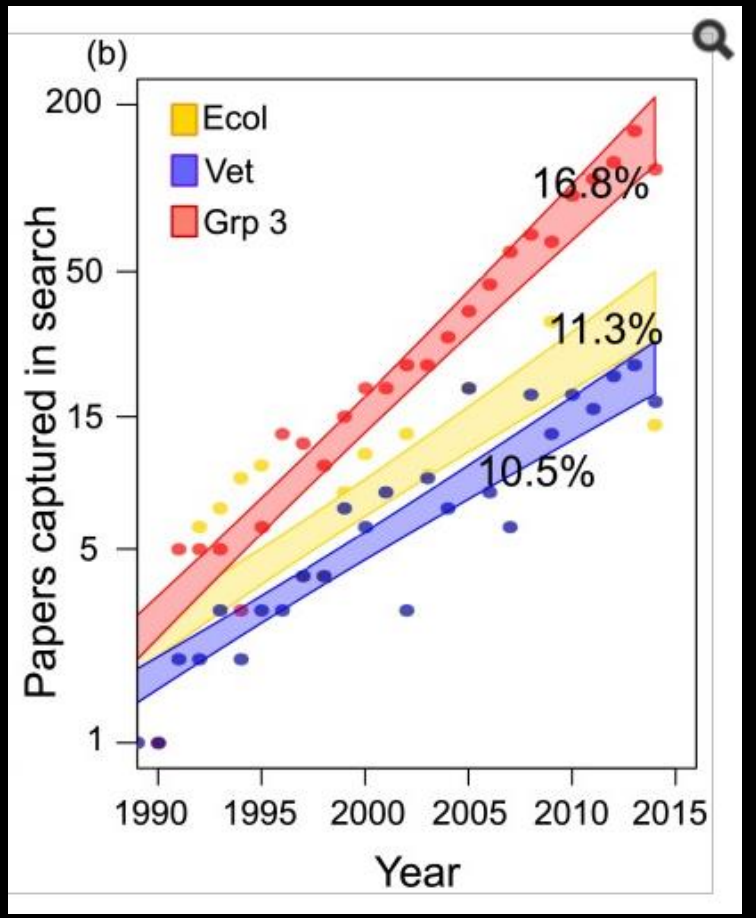
"One Health" or Three? Publication Silos Among the One Health Disciplines

Kezia R. Manlove[1]*, Josephine G. Walker[2], Meggan E. Craft[3], Kathryn P. Huyvaert[4], Maxwell B. Joseph[5], Ryan S. Miller[6], Pauline Nol[7], Kelly A. Patyk[6], Daniel O'Brien[8], Daniel P. Walsh[9], Paul C. Cross[10]

1 Department of Biology, Pennsylvania State University, University Park, Pennsylvania, United States of America, **2** School of Biological Sciences, University of Bristol, Bristol, United Kingdom, **3** Department of Veterinary Population Medicine, University of Minnesota, St. Paul, Minnesota, United States of America, **4** Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, Colorado, United States of America, **5** University of Colorado Boulder, Department of Ecology and Evolutionary Biology, Boulder, Colorado, United States of America, **6** United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Science Technology and Analysis Services, Fort Collins, Colorado, United States of America, **7** United States Department of Agriculture Animal and Plant Health Inspection Service, Veterinary Services, National Wildlife Research Center, Fort Collins, Colorado, United States of America, **8** Wildlife Disease Laboratory, Michigan Department of Natural Resources, Lansing, Michigan, United States of America, **9** U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin, United States of America, **10** U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, Montana, United States of America

CrossMark click for updates

OPEN ACCESS



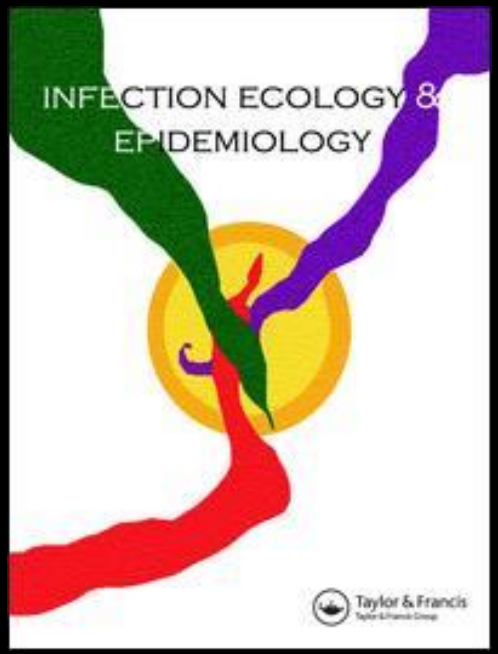
From PLOS Biology | DOI:10.1371/journal.pbio.1002448 April 21, 2016. Number of papers captured by our search through time. Blue = veterinary community; gold = ecology community; red = group 3. Numbers are the annual percent growth rate within each community.

…."The number of publications fulfilling our search criteria increased by 14.6% per year, which is faster than growth rates for life sciences as a whole and for most biology subdisciplines."

One Health Journals

International Journal of One Health

Open access and peer reviewed journal on Human, Animal and Environmental health



One Health

International Journal

One Health Conferences

ONE HEALTH SWEDEN

HUMANS | ANIMALS | ENVIRONMENT

8th Scientific Meeting

Villa Aske, Bro – March 21th-22th 2018

Human versus animal health –
different aspects on three challenging pathogens

ONE HEALTH:
ONE GLOBAL ENVIRONMENT

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MONTEGO BAY | JAMAICA
22 - 26 OCTOBER 2017

Network for Evaluation of One Health

Belgian Community of Practice on Biodiversity and Health

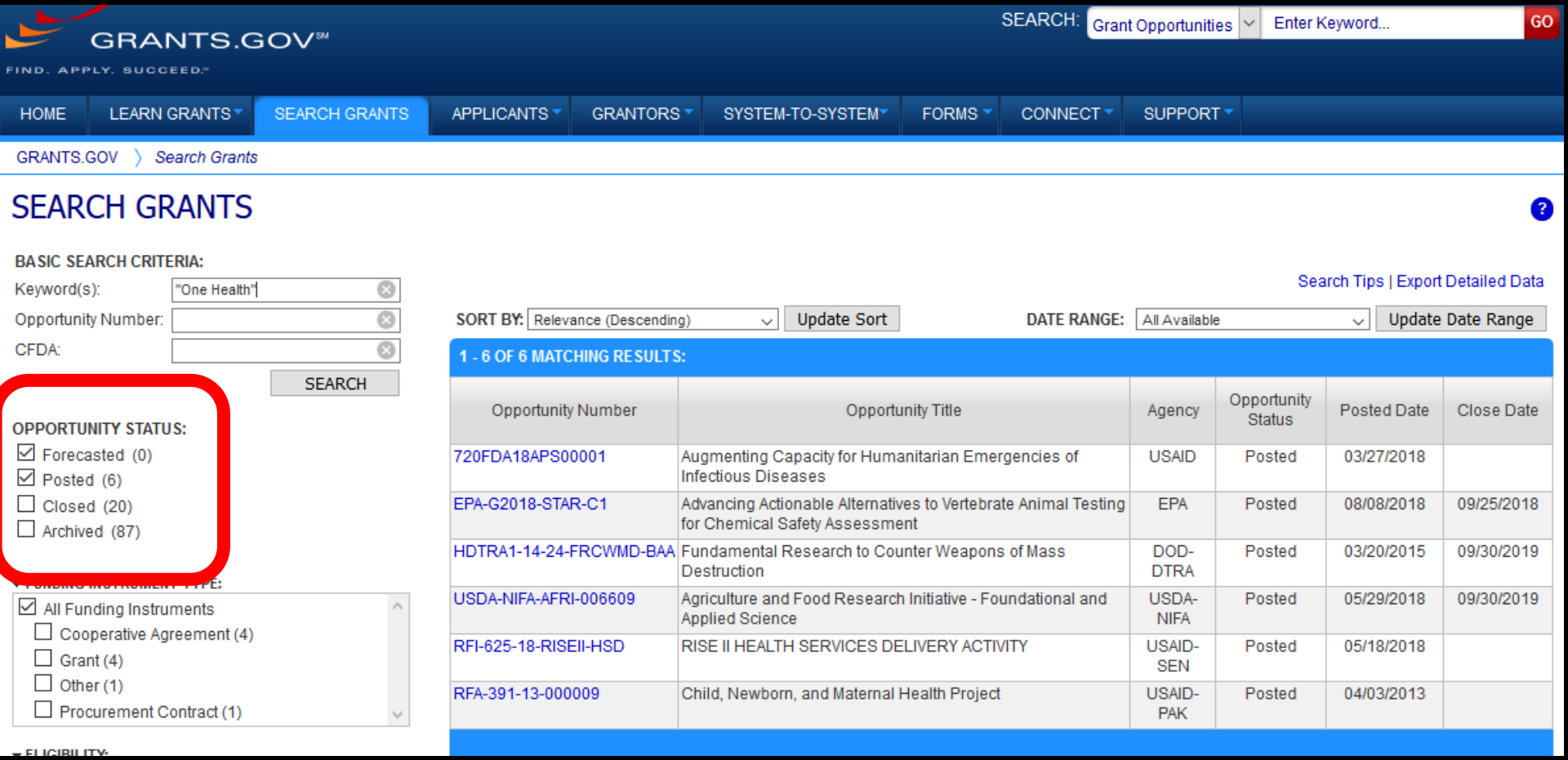
ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRO-ALIMENTARI

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

SAVE THE DATE for the Conference on

Creating impact for One Health and Ecohealth: advancements in implementation, evaluation and governance

2018 15th CDC International Symposium on Biosafety:
Biosafety in the Era of One Health



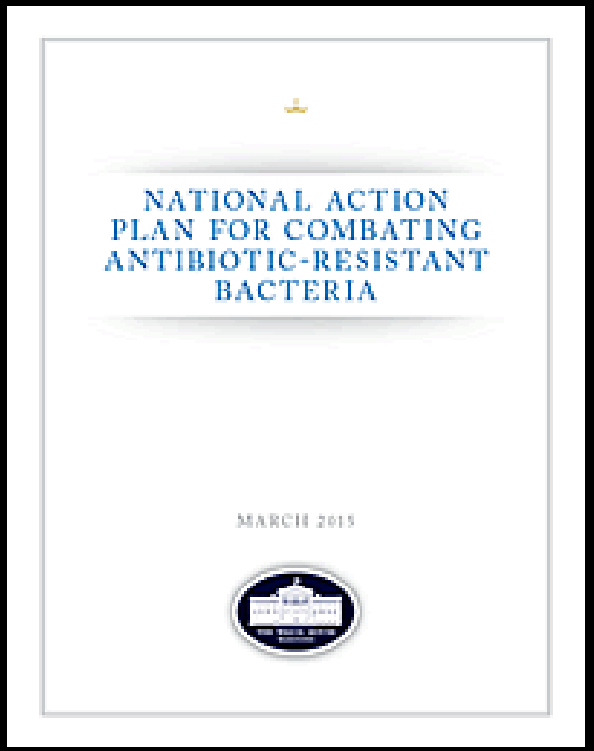
One Health has now been mentioned as a approach in more than 100 active or archived requests for proposals (RFPs) since 2007 on www.grants.gov. On 9/8/18, we extracted summary data from 96 of these RFP records (HHS, USAID, USDA, DoD, EPA) and found grant funding to total **$4,885,519,322**

Search results from Sept 8, /2018

National Action Plan For Combating Antibiotic- Resistant Bacteria

Goals

- Slow emergence / prevent spread
  - **Foster antibiotic stewardship**
- **Strengthen "One Health" surveillance**
- Develop rapid diagnostics
- Accelerate basic and applied R&D
  - New antibiotics
  - Other therapeutics
- Improve international collaboration



From James Hughes and US CDC
http://essays.biochemistry.org/content/61/1/11

G20 nations pledge to strengthen health systems, combat antimicrobial resistance

By PTI | Published: 09th July 2017 12:48 AM |
Last Updated: 09th July 2017 12:48 AM | A+ A A- |

World leaders at the G-20 summit. on Saturday.

HAMBURG: The G20 nations, including India, today pledged to strengthen health systems and also combat the menace of antimicrobial resistance, which the grouping termed as a "growing threat" to public health and economic growth.

The declaration adopted by the nations said they would aim to tackle the spread of AMR through the implementation of their respective national action plans based on "one health" approach.

"We call on the UN to keep global health high on the political agenda and we strive for cooperative action to strengthen health systems worldwide, including through developing the health workforce," the declaration said.

ONE HEALTH

OPERATIONAL FRAMEWORK FOR STRENGTHENING HUMAN, ANIMAL, AND ENVIRONMENTAL PUBLIC HEALTH SYSTEMS AT THEIR INTERFACE

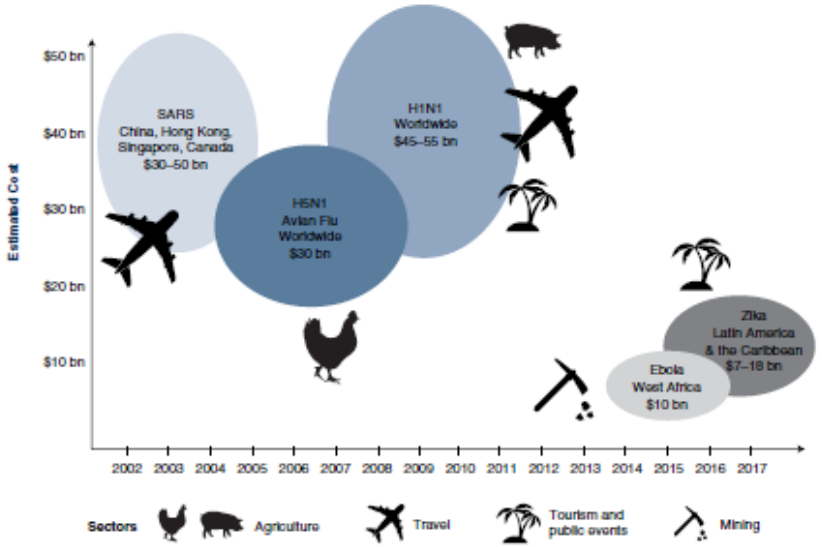
WORLD BANK GROUP

CHAPTER

2 Value of Investing in One Health

Given the high cost of emerging diseases as well as the persistent burden of endemic diseases (see Figure 2.1 and Table 2.1), One Health should be considered to assist client countries in strengthening their ability to address known and potential disease threats at the human-animal-environment interface. For a One Health approach to be warranted, it must provide added value. Fundamentally, strong sectoral health systems (e.g., human health, animal health, environmental health) must be in place—or existing systems strengthened—to support effective coordination and collaboration. Relevant metrics for value generation depend on the goal of an investment or client country, but in general, One Health offers synergies among these sectoral systems, providing expanded capacity and effectiveness in prevention of damages and/or control of disease, efficiency, and ultimately financial savings.

Figure 2.1: Examples of economic impacts of disease outbreaks (see also Table 2.1); icons represent examples of highly-affected sectors.



Figures are estimates and are presented as relative size. Based upon BioEra, World Bank, and UNDP data. Chart updated by EcoHealth Alliance.

EXHIBIT HEALTH, MICROBES, ANIMALS

'Outbreak' puts the life cycle of an epidemic on display

A new Smithsonian exhibit highlights how infectious diseases shape our world

BY LAUREL HAMERS 7:00AM, JUNE 4, 2018

SOCIAL EPIDEMIC In a new Smithsonian exhibit, activist signs and buttons from the AIDS epidemic highlight some of the social consequences of infectious disease outbreaks.

JAMES DI LORETO AND LUCIA RM MARTINO/SMITHSONIAN INSTITUTION

In 1918, a pandemic of Spanish flu killed as much as 5 percent of the world's population. A hundred years later, scientists know much more about how to prevent and treat such diseases. But in some ways, the threat of a global outbreak is greater than ever. All it takes is one plane ride for a few localized cases of a disease to become an epidemic.

A new exhibit at the Smithsonian National Museum of Natural History in Washington, D.C., traces the way infectious diseases still shape our world. The exhibit, called "Outbreak: Epidemics in a Connected World," is

March 22, 2018
U.S. Senate One Health Bill S. 2615 introduced to Congress: 'Advancing Emergency Preparedness Through One Health Act of 2018''

A bipartisan **Bill** was introduced to the U.S. Senate floor by Senators Tina Smith (D-MN) and Todd Young (R-IN). If enacted, it would require the U.S. Department of Health and Human Services (HHS) and the US Department of Agriculture to coordinate with other relevant agencies to develop a U.S. Federal One Health Framework that would: (https://goo.gl/6ydyng)

- advance workforce development for prevention and response to disease outbreaks in animals and humans,
- improve coordination between federal agencies who study human and animal health and the environment and
- advance scientific understanding of the connections between human, animal, and environmental health.

Description of Bill. (https://goo.gl/LJbDT2) Supporters may wish to voice their opinions.

Superbugs: MEPs advocate further measures to curb use of antibiotics

Press Releases | PLENARY SESSION | ENVI | Yesterday

- "One Health": acknowledge clear link between human and animal health
- Curb use of existing antimicrobials, give incentives to develop new ones
- Need for comparable data and cheaper diagnostic tests

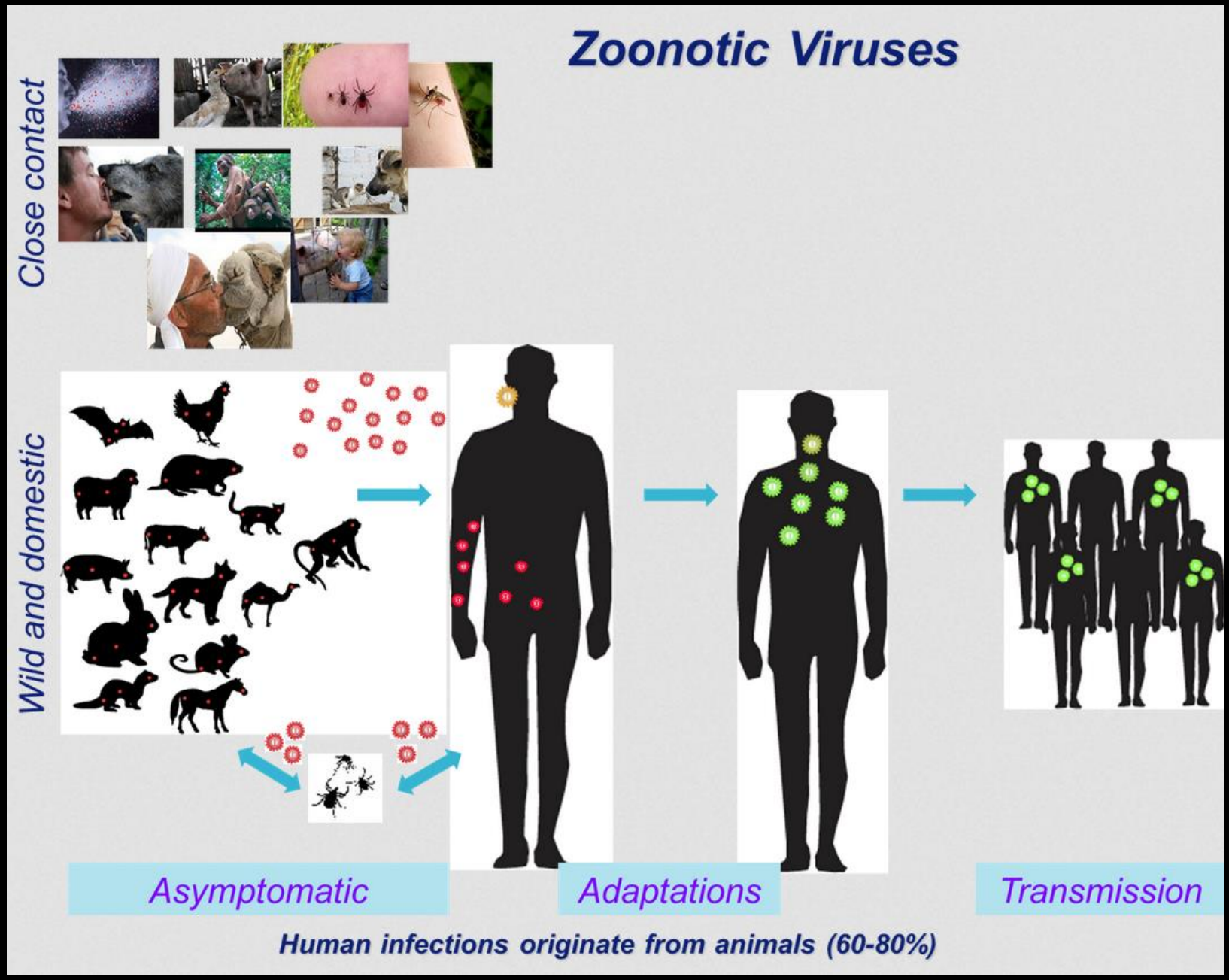
Fighting drug-resistant infections

The growing threat posed by antibiotic-resistant bacteria can only be tackled through a "One Health" approach, MEPs said on Wednesday.

In the non-binding resolution, adopted with 589 votes to 12 and 38 abstentions, MEPs stress that the correct and prudent use of antimicrobials is essential to limit antimicrobial resistance (AMR) from emerging in human healthcare, animal husbandry and aquaculture.

The food chain and the environment also need to be taken into account, as they are potential sources of resistant microorganisms, say MEPs.

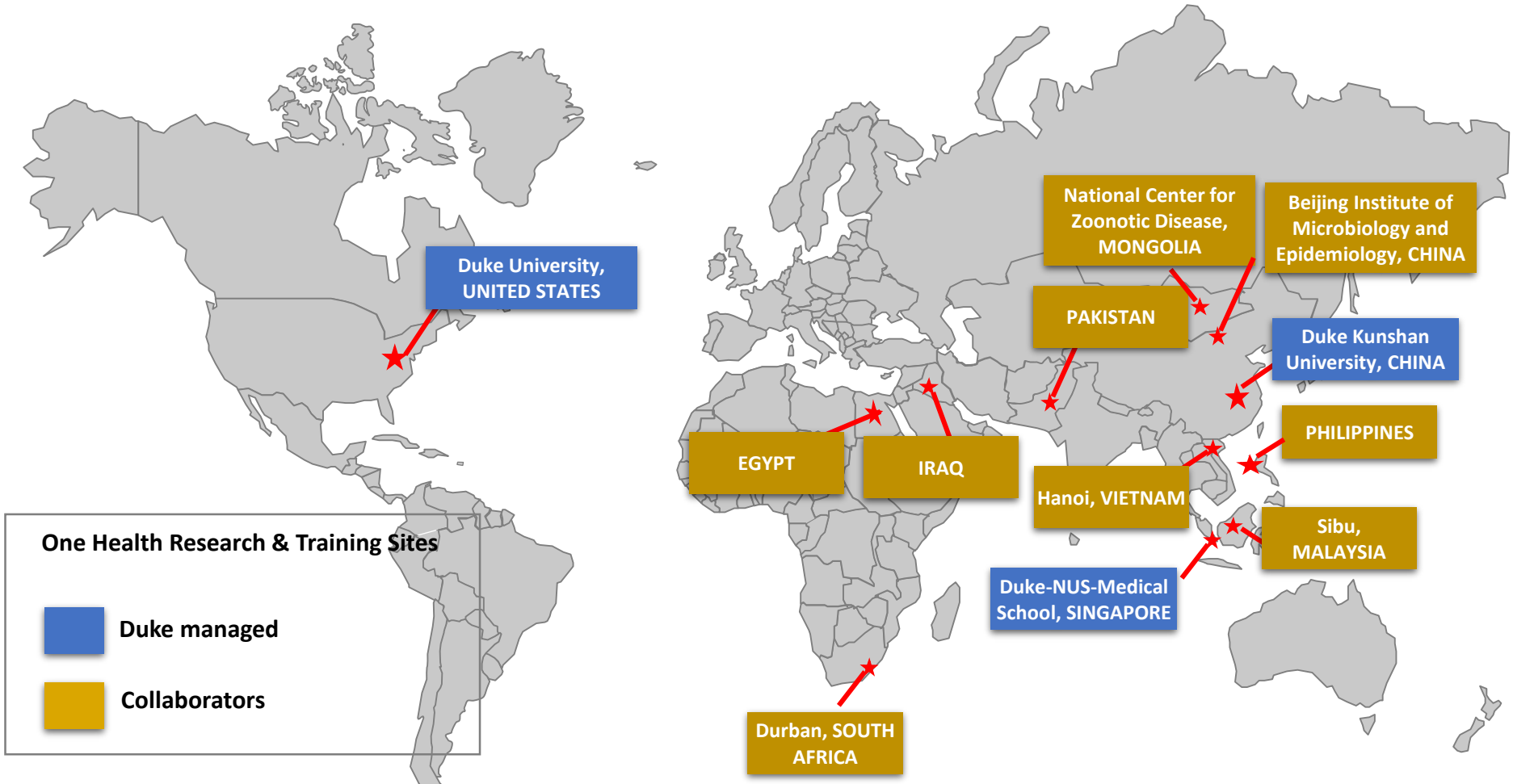
How do we apply the One Health approach to research in our Duke network?



From http://www.iisertvm.ac.in/faculties/stalin/research_areas.phpx


Where are large groups of people and animal mixing?

Duke One Health Research & Training, 2017-2018



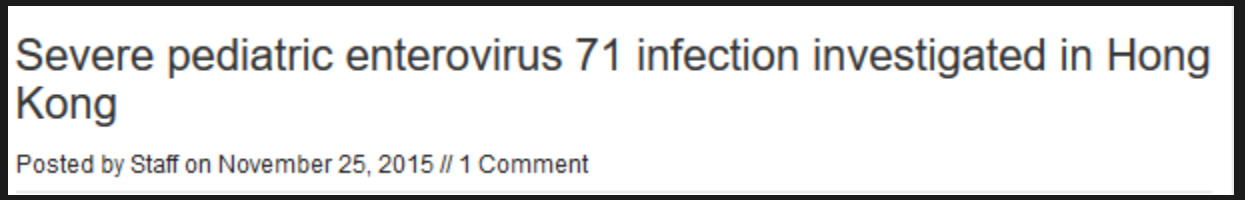
Duke UNIVERSITY

Our One Health Laboratory's Focus - Novel Respiratory Virus Detection & Epidemiological Study

Panspecies (human and animal) diagnostics for:
Influenza A,B,C,D
Adenovirus
Coronaviruses
Enteroviruses


Enterovirus D68 found in 4 patients who have died, including 10-year-old girl

By Jacque Wilson and Greg Botelho, CNN
Updated 9:16 AM ET, Thu October 2, 2014

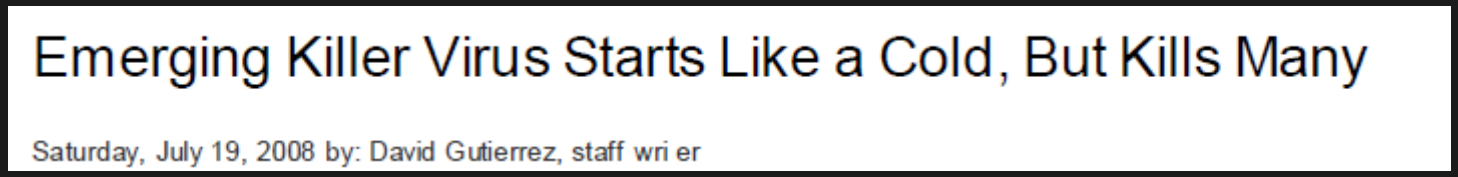

Severe pediatric enterovirus 71 infection investigated in Hong Kong

Posted by Staff on November 25, 2015 // 1 Comment

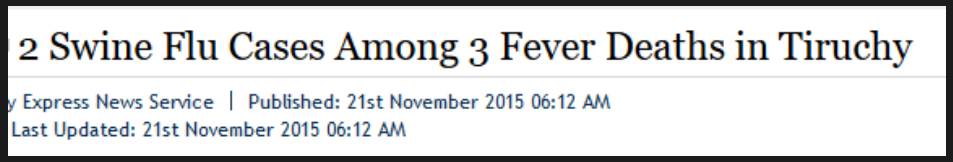

FOXNEWS.COM HOME > HEALTH

CDC: Deadly Mutation of Common Cold Kills 10, Sickens 140 in Past 18 Months

Friday, November 16, 2007


Emerging Killer Virus Starts Like a Cold, But Kills Many

Saturday, July 19, 2008 by: David Gutierrez, staff wri er


2 Swine Flu Cases Among 3 Fever Deaths in Tiruchy

y Express News Service | Published: 21st November 2015 06:12 AM
Last Updated: 21st November 2015 06:12 AM

Table 1. Characteristics of influenza viruses

Virus type	Year of virus discovery	Number of gene segments	Available antiviral therapy	Seasonal vaccine routinely available
Influenza A	1931	8	Oseltamivir, peramivir, zanamivir, amantadine, rimatadine	Yes
Influenza B	1940	8	Oseltamivir, zanamivir	Yes
Influenza C	1974	7	No effective antiviral treatment available	No
Influenza D	2011	7	No antiviral treatment available	No

Journal of Clinical Virology 81 (2016) 31–33

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Journal of Clinical Virology

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Short communication

Serologic evidence of exposure to influenza D virus among persons with occupational contact with cattle

Sarah K. White[a,b], Wenjun Ma[c], Clinton J. McDaniel[a,b], Gregory C. Gray[d], John A. Lednicky[a,b,*]

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ABSTRACT

Background: Influenza D virus (IDV), a novel influenza virus with proposed classification: family *Orthomyxoviridae*, genus *Influenzavirus D*, species *Influenza D virus*, has been associated with influenza-like illness in cattle and swine. More recently, anti-IDV antibodies have also been detected in small ruminants. A seroprevalence of approximately 1.3% has been estimated for the general human population.
Objectives: To gain insights on the zoonotic potential of IDV to human adults with occupational exposure to cattle in north central Florida.
Study: A cross-sectional serological study was performed on human serum samples from 35 cattle-exposed and 11 non-cattle-exposed adults to screen for IDV antibodies using hemagglutination inhibition (HI) and microneutralization (MN) assays.
Results: A seroprevalence of 91% was detected via HI assay, and 97% by MN assay among individuals working with cattle in Florida. Among non-cattle-exposed individuals, seropositivity determined via MN assay (only) was lower (18%).
Conclusions: IDV poses a zoonotic risk to cattle-exposed workers, based on detection of high seroprevalence (94–97%). Whereas it is still unknown whether IDV causes disease in humans, our studies indicate that the virus may be an emerging pathogen among cattle-workers.

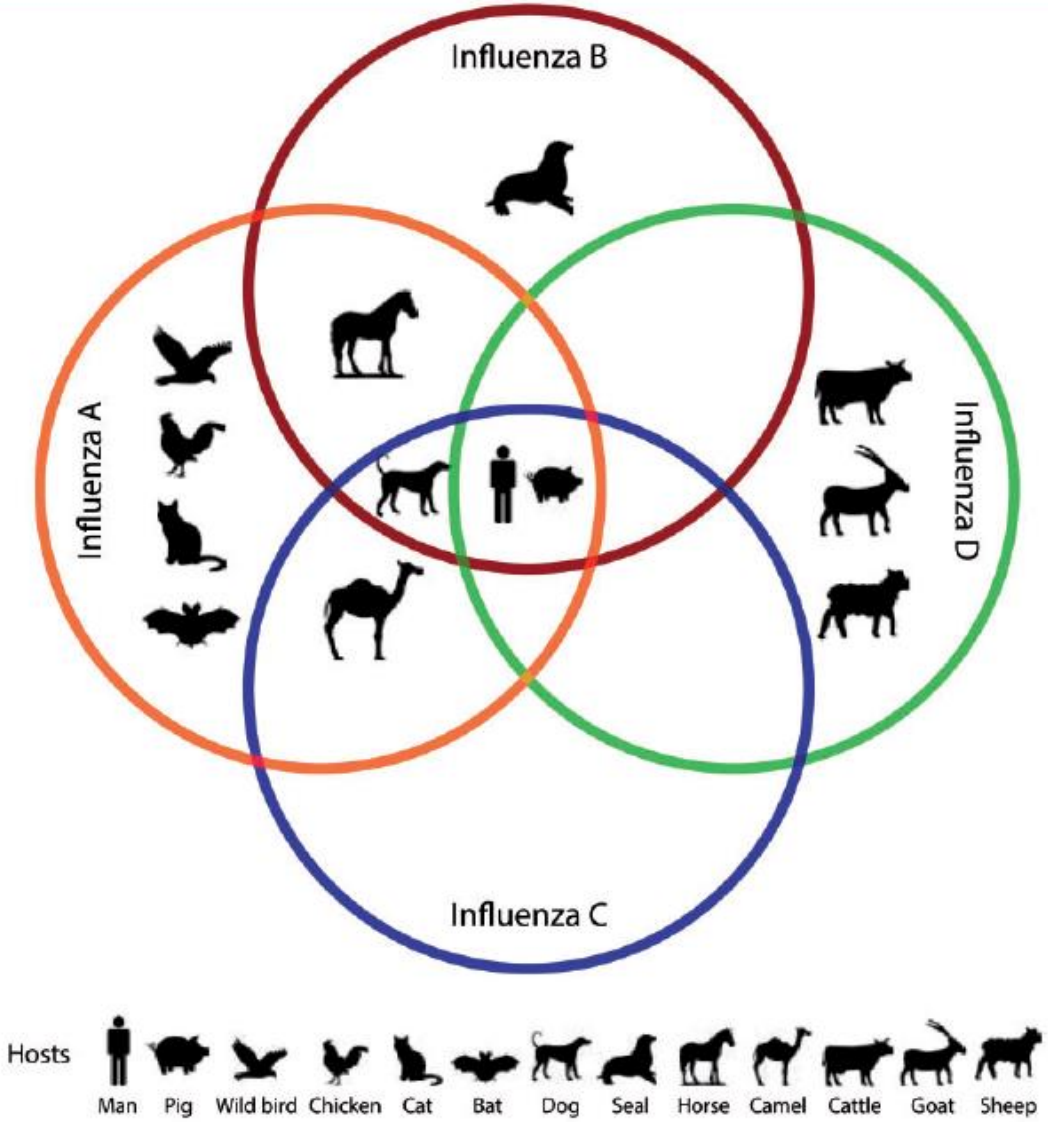

Figure 1. Graphical summary of the reports of human and animal infections with the various influenza viruses (Genera influenza virus A, B, C, & D). It is interesting to note that humans and pigs are thought to be susceptible to all four influenza genera. Among the animals with documented influenza infections, many are domestic animals. In particular, poultry and pigs serve as important amplifying reservoirs for influenza A virus infections in man

frontiers in Public Health

MINI REVIEW
published: 09 April 2018
doi: 10.3389/fpubh.2018.00104

A Mini Review of the Zoonotic Threat Potential of Influenza Viruses, Coronaviruses, Adenoviruses, and Enteroviruses

Emily S. Bailey[1,2]*, *Jane K. Fieldhouse*[1,2], *Jessica Y. Choi*[1,2] and *Gregory C. Gray*[1,2,3,4]

[1] *Duke Global Health Institute, Duke University, Durham, NC, United States,* [2] *Division of Infectious Diseases, Duke University School of Medicine, Durham, NC, United States,* [3] *Global Health Research Center, Duke-Kunshan University, Kunshan, China,* [4] *Emerging Infectious Diseases Program, Duke-NUS Medical School, Singapore*

During the last two decades, scientists have grown increasingly aware that viruses are emerging from the human–animal interface. In particular, respiratory infections are problematic; in early 2003, World Health Organization issued a worldwide alert for a previously unrecognized illness that was subsequently found to be caused by a novel coronavirus [severe acute respiratory syndrome (SARS) virus]. In addition to SARS, other respiratory pathogens have also emerged recently, contributing to the high burden of respiratory tract infection-related morbidity and mortality. Among the recently emerged respiratory pathogens are influenza viruses, coronaviruses, enteroviruses, and adenoviruses. As the genesis of these emerging viruses is not well understood and their detection normally occurs after they have crossed over and adapted to man, ideally, strategies for such novel virus detection should include intensive surveillance at the human–animal interface, particularly if one believes the paradigm that many novel emerging zoonotic viruses first circulate in animal populations and occasionally infect man before they fully adapt to man; early detection at the human–animal interface will provide earlier warning. Here, we review recent emerging virus treats for these four groups of viruses.

OPEN ACCESS

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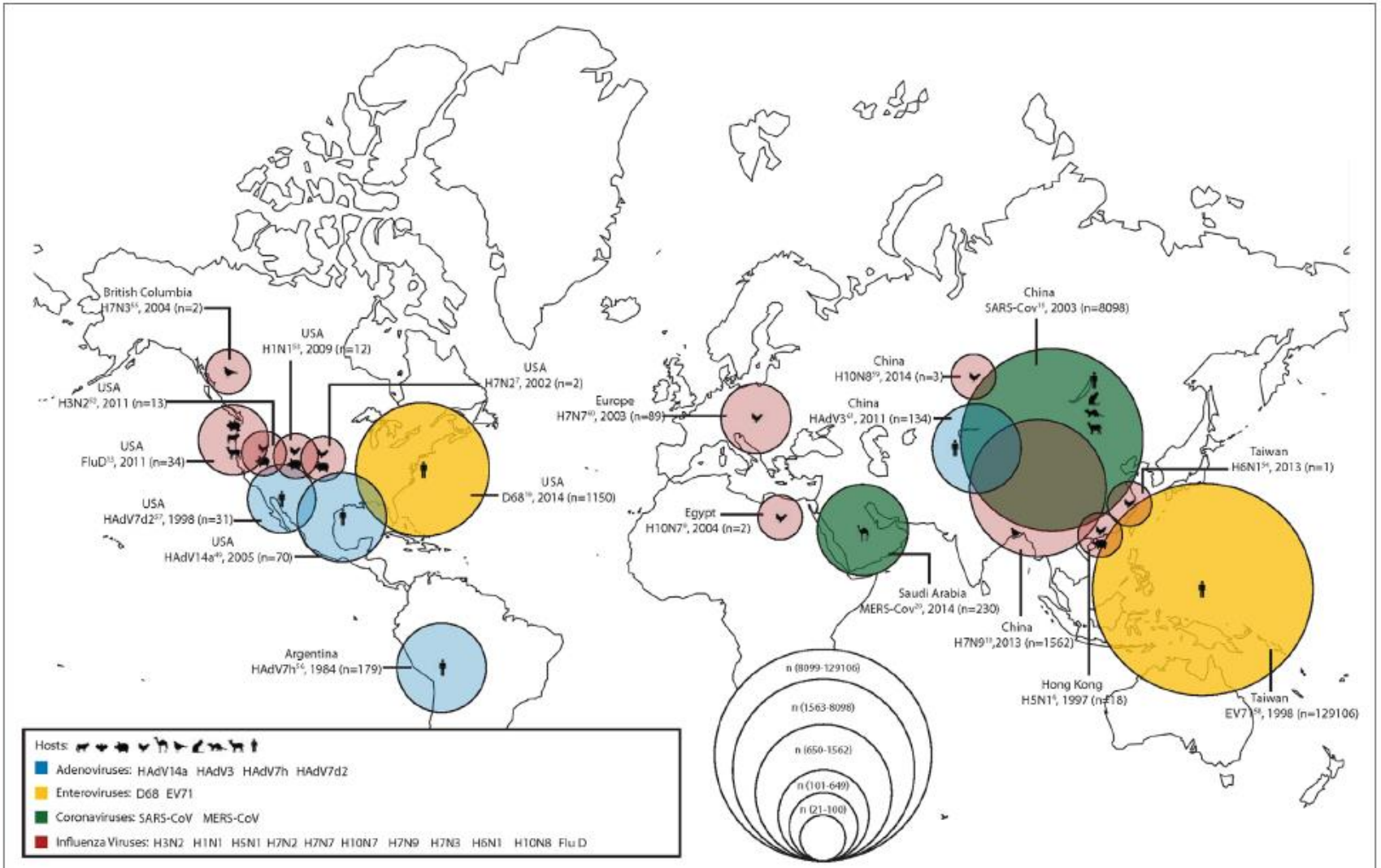
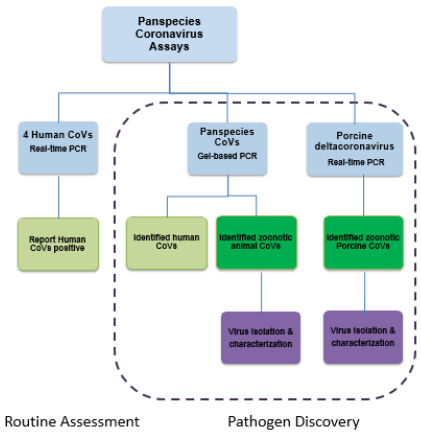


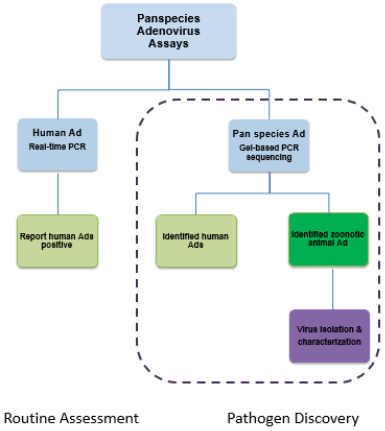
FIGURE 1 | The geographical location of first detections (with known reservoirs) for recently emerged adenoviruses (Ads), enteroviruses (EVs), coronaviruses, and influenza viruses. Zoonotic (coronaviruses and influenza viruses) and non-zoonotic viruses (Ads and EVs) are shown. For zoonotic viruses, the hosts range from cattle, bats, chickens, camels, wild birds, cats, ferrets, goats, and humans (from left to right). The different sizes of the circles represent the number of human cases during the first outbreaks of the emerging respiratory viruses. Human cases of adenoviral infections are shown in blue; human cases of enteroviral infections are shown in yellow; human cases of coronaviral infections are shown in green; and human cases of influenza viral infections are shown in red.

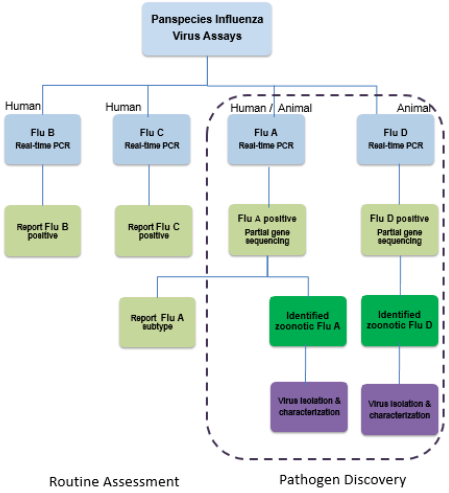
December 17, 2015

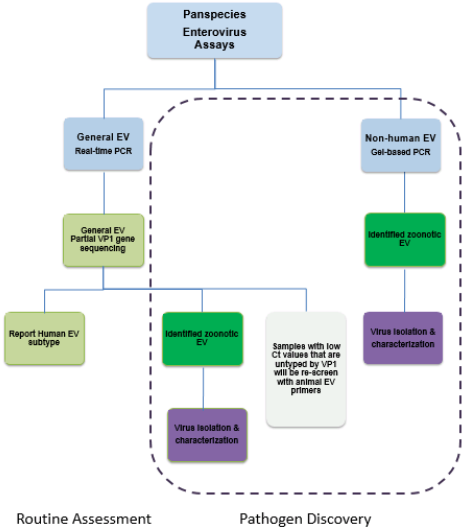
Detecting Novel Respiratory Viruses that Emerge from the Human-Animal Interface

Molecular Detection Algorithms









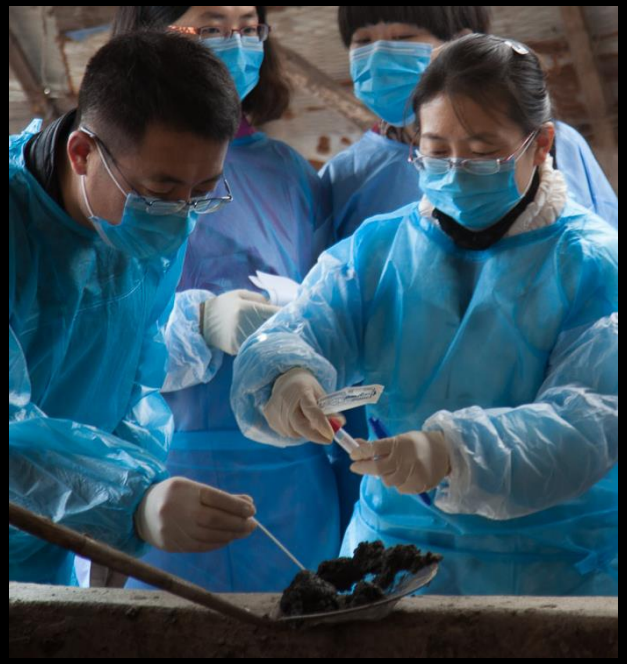
Zoonotic Swine Influenza Virus Transmission in Confined Animal Feeding Operations 1R01AI108993-01A1

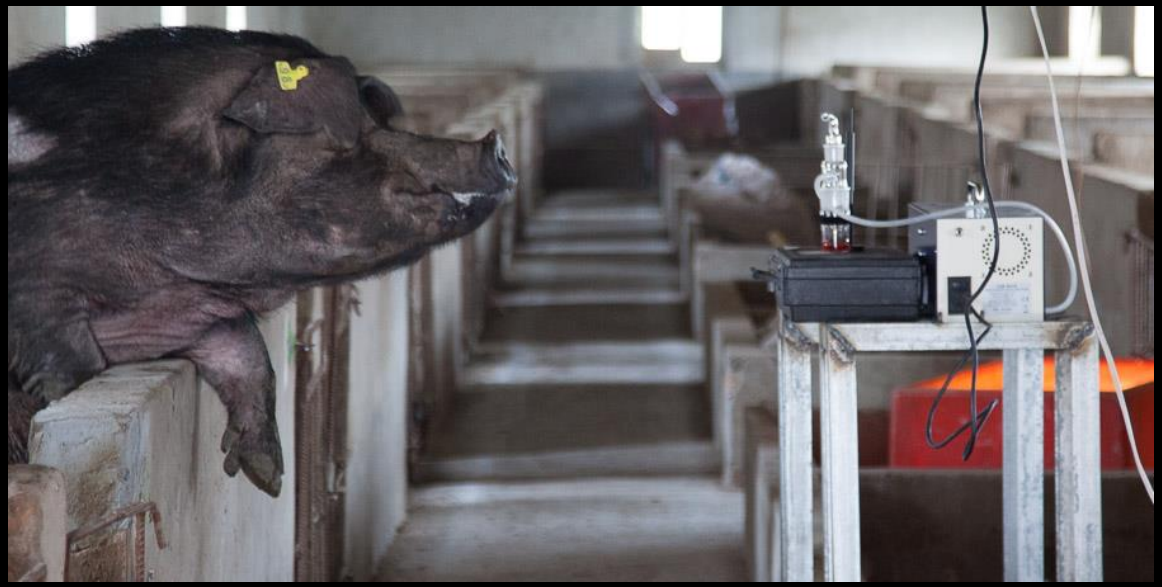
Gregory C. Gray and Wu-Chun Cao

- Enrollment questionnaire & sera from 300 exposed and 100 nonexposed workers (6 farms)
- Annual serum sampling
- Annual risk factor questionnaire
- Weekly monitoring for ILI & influenza A
- ILI questionnaire
- ILI sera and swabs

- Monthly rope swab sampling of 50 pigs
- Sample various ages (sows, boars, and production pigs)
- 50 pens x 6 farms per month = 300 rope swabs per month

- CAFO questionnaire
- Multiple CAFOs in separate provinces
- Monthly environmental studies of CAFO environment for influenza A
- 144 total aerosol, fecal, environmental swab, and water samples/per month





Results

When visiting the farms our research teams noted a frequent lack of biosecurity and sparse use of personal protective equipment, especially in the older and smaller farms. In at least three farms, ducks, geese, chickens, or dogs were housed very near or found comingling with pigs. Often there were no barriers to separate pigs from birds or rodents

Clinical Infectious Diseases

MAJOR ARTICLE

Evidence for Cross-species Influenza A Virus Transmission Within Swine Farms, China: A One Health, Prospective Cohort Study

Mai-Juan Ma,[1,a] Guo-Lin Wang,[1,a] Benjamin D. Anderson,[2] Zhen-Qiang Bi,[3,4] Bing Lu,[5] Xian-Jun Wang,[3,4] Chuang-Xin Wang,[6] Shan-Hui Chen,[5] Yan-Hua Qian,[5] Shao-Xia Song,[3,4] Min Li,[6] John A. Lednicky,[7] Teng Zhao,[1] Meng-Na Wu,[1] Wu-Chun Cao,[1,b] and Gregory C. Gray[2,8,9,b]

[1]State Key Laboratory of Pathogen and Biosecurity, Beijing Institute of Microbiology and Epidemiology, China; [2]Global Health Institute, Division of Infectious Diseases, School of Medicine, Duke University, Durham, North Carolina; [3]Shandong Provincial Center for Disease Control and Prevention and [4]Shandong Provincial Key Laboratory of Disease Control and Prevention, Jinan, [5]Wuxi Center for Disease Control and Prevention, Wuxi, and [6]Licheng District Center for Disease Control and Prevention, Jinan, China; [7]Department of Environmental and Global Health, College of Public Health and Health Professions, University of Florida, Gainesville; [8]Global Health Research Center, Duke-Kunshan University, Kunshan, China; and [9]Program in Emerging Infectious Diseases, Duke-NUS Medical School, Singapore

Background. Our understanding of influenza A virus transmission between humans and pigs is limited.

Methods. Beginning in 2015, we used a One Health approach and serial sampling to prospectively study 299 swine workers and 100 controls, their 9000 pigs, and 6 pig farm environments in China for influenza A viruses (IAVs) using molecular, culture, and immunological techniques. Study participants were closely monitored for influenza-like illness (ILI) events.

Results. Upon enrollment, swine workers had higher serum neutralizing antibody titers against swine H1N1 and higher nasal wash total immunoglobulin A (IgA) and specific IgA titers against swine H1N1 and H3N2 viruses. Over a period of 12 months, IAVs were detected by quantitative reverse-transcription polymerase chain reaction in 46 of 396 (11.6%) environmental swabs, 235 of 3300 (7.1%) pig oral secretion, 23 of 396 (5.8%) water, 20 of 396 (5.1%) aerosol, and 19 of 396 (4.8%) fecal-slurry specimens. Five of 32 (15.6%) participants with ILI events had nasopharyngeal swab specimens that were positive for IAV, and 17 (53.1%) demonstrated 4-fold rises in neutralization titers against a swine virus. Reassorted Eurasian avian-lineage H1N1, A(H1N1)pdm09-like, and swine-lineage H3N2 viruses were identified in pig farms. The A(H1N1)pdm09-like H1N1 viruses identified in swine were nearly genetically identical to the human H1N1 viruses isolated from the participants with ILI.

Conclusions. There was considerable evidence of A(H1N1)pdm09-like, swine-lineage H1N1, and swine-lineage H3N2 viruses circulating, likely reassorting, and likely crossing species within the pig farms. These data suggest that stronger surveillance for novel influenza virus emergence within swine farms is imperative.

Keywords. One Health; influenza A virus; swine; China; emerging pathogens.

https://www.youtube.com/watch?v=LGcNlEjYVFI

RESEARCH ARTICLE

Surveillance for respiratory and diarrheal pathogens at the human-pig interface in Sarawak, Malaysia

Laura K. Borkenhagen[1,2☯], Kerry A. Mallinson[1☯], Rick W. Tsao[1☯], Siaw-Jing Ha[3,4], Wei-Honn Lim[5], Teck-Hock Toh[3,4,5], Benjamin D. Anderson[2], Jane K. Fieldhouse[1,2], Sarah E. Philo[1,2], Kuek-Sen Chong[3,6], William G. Lindsley[7], Alejandro Ramirez[8], James F. Lowe[9], Kristen K. Coleman[10], Gregory C. Gray[1,2,10]

Background

The large livestock operations and dense human population of Southeast Asia are considered a hot-spot for emerging viruses.

Objectives

To determine if the pathogens adenovirus (ADV), coronavirus (CoV), encephalomyocarditis virus (EMCV), enterovirus (EV), influenza A-D (IAV, IBV, ICV, and IDV), porcine circovirus 2 (PCV2), and porcine rotaviruses A and C (RVA and RVC), are aerosolized at the animal-interface, and if humans working in these environments are carrying these viruses in their nasal airways.

Conclusions

This study demonstrates that nucleic acids from a number of targeted viruses were present in pig oral secretions and pig fecal samples, and that several viruses were detected in bioaerosol samples or in the nasal passages of humans with occupational exposure to pigs. These results demonstrate the need for future research in strengthening viral surveillance at the human-animal interface, specifically through expanded bioaerosol sampling efforts and a seroepidemiological study of individuals with exposure to pigs in this region for PCV2 infection.

Clinical Infectious Diseases

MAJOR ARTICLE

Bioaerosol Sampling to Detect Avian Influenza Virus in Hanoi's Largest Live Poultry Market

Vuong N. Bui,[1] Tham T. Nguyen,[2] Hung Nguyen-Viet,[3,4] Anh N. Bui,[1] Katie A. McCallion,[5] Hu Suk Lee,[3] Son T. Than,[1] Kristen K. Coleman,[2] and Gregory C. Gray[2,6,7]

[1]Virology Department, National Institute of Veterinary Research, Hanoi, Vietnam; [2]Program in Emerging Infectious Diseases, Duke-NUS Medical School, Singapore; [3]International Livestock Research Institute, Hanoi, Vietnam, and [4]Center for Public Health and Ecosystem Research, Hanoi University of Public Health, Vietnam; [5]College of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina, and [6]Division of Infectious Diseases, Global Health Institute, and Nicholas School of the Environment, Duke University, Durham, North Carolina; and [7]Global Health Research Center, Duke-Kunshan University, China

Background. Newly emergent and virulent strains of H7N9 avian influenza virus are rapidly spreading in China and threaten to invade Vietnam. We sought to introduce aerosol sampling for avian influenza viruses in Vietnam.

Methods. During October 2017, National Institute for Occupational Safety and Health 2-stage aerosol samplers were assembled on a tripod and run for 4 hours. Concomitantly, up to 20 oropharyngeal (OP) swab samples were collected from chickens and ducks distanced at 0.2–1.5 m from each sampler.

Results. The 3 weeks of sampling yielded 30 aerosol samples that were 90% positive for influenza A, by quantitative reverse-transcription polymerase chain reaction, and 116 OP swab sample pools (5 samples per pool) that were 47% positive. Egg cultures yielded 1 influenza A virus (not H5 or H7) from aerosol and 25 influenza A viruses from OP swab sample pools (5 were H5 positive). The association between positive sample types (over time and position) was strong, with 91.7% of positive OP pooled swab samples confirmed by positive aerosol samples and 81% of influenza A positive aerosol samples confirmed by positive OP swab samples.

Conclusions. We posit that aerosol sampling might be used for early warning screening of poultry markets for novel influenza virus detection, such as H7N9. Markets with positive aerosol samples might be followed up with more focused individual bird or cage swabbing, and back-tracing could be performed later to locate specific farms harboring novel virus. Culling birds in such farms could reduce highly pathogenic avian influenza virus spread among poultry and humans.

Keywords. avian influenza; influenza A virus; Vietnam; poultry; epidemiology.

Clin Infect Dis. 2018 Aug 31. doi: 10.1093/cid/ciy583

Field Validation of InDevR FluChip-8G Multiplexed, Multipurpose Influenza Diagnostic System

Funding:
National Institutes of Health
Biomedical Advance Research and Development Authority

Rationale:
Under the leadership of Dr. Gregory Gray, the Duke One Health team has been studying zoonotic influenza virus across Southeast Asia and the US. These cross-sectional and prospective studies have targeted various agricultural occupational groups with a focus on the transmission of zoonotic and emerging viruses. In this proposal, we will conduct a 12-month field validation study of the InDevR FluChip-8G assay using both human and animal origin samples.

FluChip Imaging System

FluChip Custom Software

FluChip Reagent Kit

Objective 1 - Early Warning System for Pandemic Preparedness: Work with Dr. Greg Gray/Duke University to field validate the FluChip-8G assay at Duke University, Durham, NC. FluChip-8G offers the ability to subtype 'non-seasonal' influenza viruses and could be added to the currently ongoing pneumonia studies in humans.

Objective 2 - Goal #2 – Non-seasonal Influenza Surveillance: Work with Dr. Greg Gray/Duke University/Duke Kunshan University (Kunshan, Jiangsu, China) to field validate the FluChip-8G assay both human and animal-origin samples in an area where significant potential for infection with non-seasonal influenza (swine, avian) exists.

Sampling Air for Viruses

Bioaerosol Sampling

Partners
North Carolina State University
University of Florida
NIOSH

Airborne Detection and Quantification of Swine Influenza A Virus in Air Samples Collected Inside, Outside and Downwind from Swine Barns

Cesar A. Corzo[1], Marie Culhane[1,2], Scott Dee[3], Robert B. Morrison[1], Montserrat Torremorell[1]*

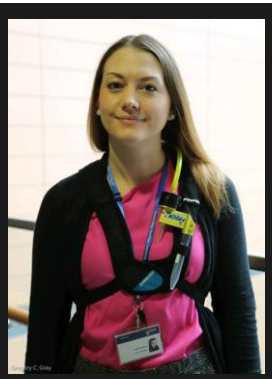
Scientists still at a loss to explain spread of avian flu

Lorna Benson · Apr 20, 2015 Business

Research shows airborne transmission of avian flu a possibility

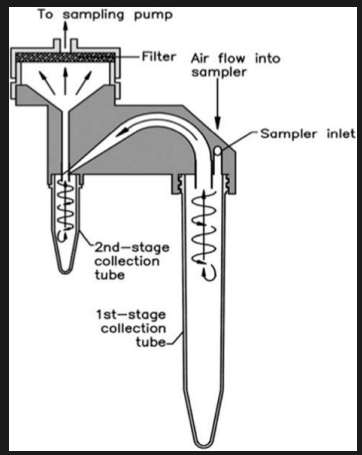
By Tom Cherveny on Jun 21, 2015 at 8:30 p.m.

SKC BioSampler



Midwest Micro Tek air sampling kits

SKC personal sampler and filter



NIOSH 2-stage sampler

Aerosol sampling a powerful screening tool

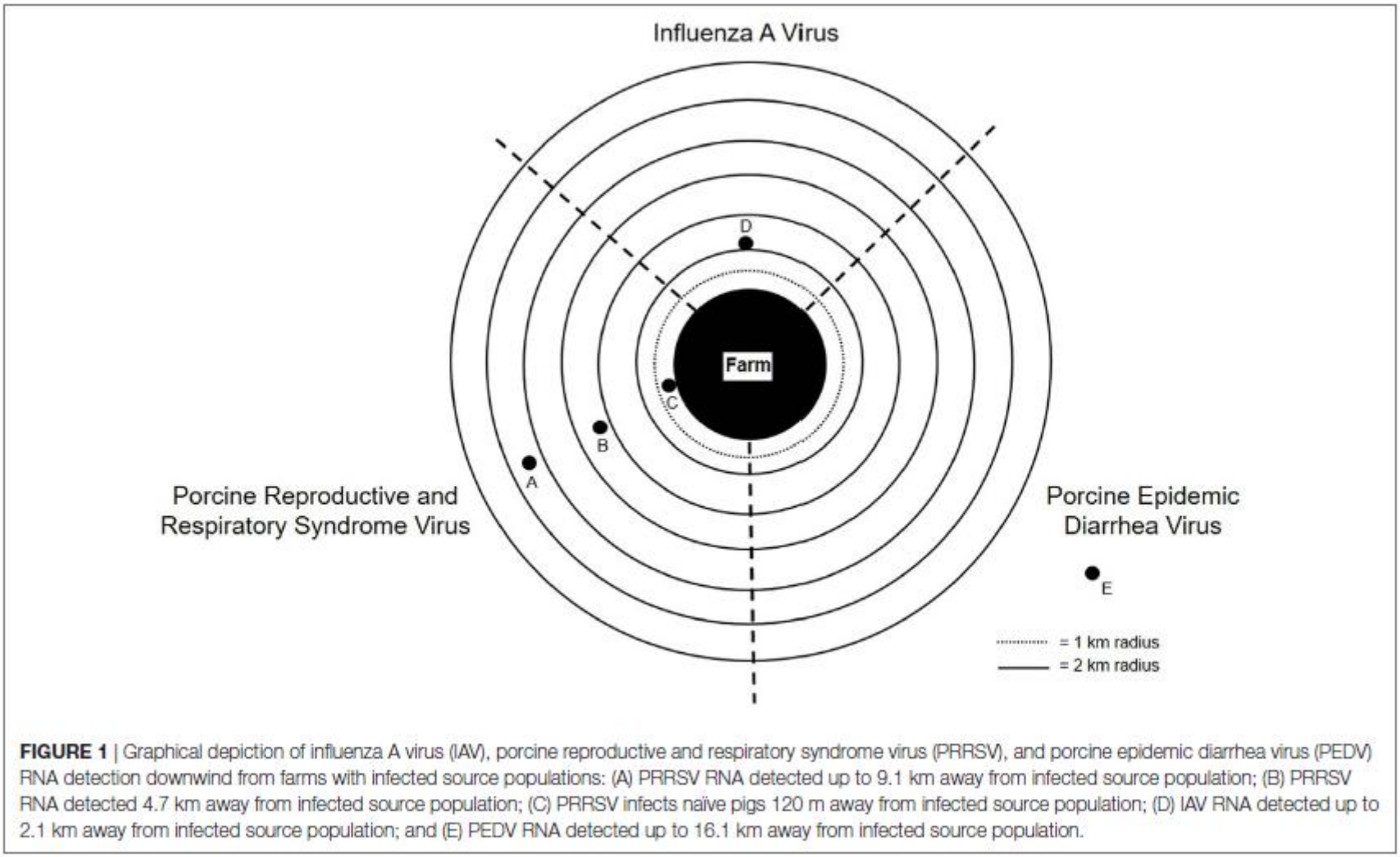


FIGURE 1 | Graphical depiction of influenza A virus (IAV), porcine reproductive and respiratory syndrome virus (PRRSV), and porcine epidemic diarrhea virus (PEDV) RNA detection downwind from farms with infected source populations: (A) PRRSV RNA detected up to 9.1 km away from infected source population; (B) PRRSV RNA detected 4.7 km away from infected source population; (C) PRRSV infects naïve pigs 120 m away from infected source population; (D) IAV RNA detected up to 2.1 km away from infected source population; and (E) PEDV RNA detected up to 16.1 km away from infected source population.

Anderson BD, Lednicky JA, Torremorell M, and Gray GC. The Use of Bioaerosol Sampling for Airborne Virus Surveillance in Swine Production Facilities: a Mini Review. Front. Vet. Sci. 27 July 2017. doi: 10.3389/fvets.2017.00121.

The Journal of Infectious Diseases
MAJOR ARTICLE

Bioaerosol Sampling in Modern Agriculture: A Novel Approach for Emerging Pathogen Surveillance?

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Background. Modern agricultural practices create environmental conditions conducive to the emergence of novel pathogens. Current surveillance efforts to assess the burden of emerging pathogens in animal production facilities in China are sparse. In Guangdong Province pig farms, we compared bioaerosol surveillance for influenza A virus to surveillance in oral pig secretions and environmental swab specimens.

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Major article

Environmental sampling for respiratory pathogens in Jeddah airport during the 2013 Hajj season

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LETTER TO THE EDITOR

Aerosolized avian influenza A (H5N6) virus isolated from a live poultry market, China

Dear Editor,

15 Centrifugal Filter Units (EMD Millipore, Billerica, MA) at 2500 g for 15 min. Total nucleic acid was extracted using the QIAxtractor (Qiagen, Inc., Venlo, The Netherlands) and then tested for influenza A virus RNA (vRNA) using a real-time reverse transcription polymerase chain reaction (rRT-PCR).[9]

Positive samples were inoculated into embryonated

Open Forum Infectious Diseases
MAJOR ARTICLE

Bioaerosol Sampling in Clinical Settings: A Promising, Noninvasive Approach for Detecting Respiratory Viruses

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Background. Seeking a noninvasive method to conduct surveillance for respiratory pathogens, we sought to examine the usefulness of 2 types of off-the-shelf aerosol samplers to detect respiratory viruses in Singapore.

Methods. In this pilot study, we ran the aerosol samplers several times each week with patients present in the patient waiting areas at 3 primary health clinics during the months of April and May 2016. We used a SKC BioSampler with a BioLite Air Sampling Pump (run for 60 min at 8 L/min) and SKC AirChek TOUCH personal air samplers with polytetrafluoroethylene Teflon filter cassettes (run for 180 min at 5 L/min). The aerosol specimens and controls were studied with molecular assays for influenza A virus, influenza B virus, adenoviruses, and coronaviruses.

Results. Overall, 16 (33.3%) of the 48 specimens indicated evidence of at least 1 respiratory pathogen, with 1 (2%) positive for influenza A virus, 3 (6%) positive for influenza B virus, and 12 (25%) positive for adenovirus.

Conclusions. Although we were not able to correlate molecular detection with individual patient illness, patients with common acute respiratory illnesses were present during the samplings. Combined with molecular assays, it would suggest that aerosol sampling has potential as a noninvasive method for novel respiratory virus detection in clinical settings.

Keywords. adenoviruses; bioaerosol; epidemiology; influenza viruses; respiratory viruses.

BIOAEROSOL SAMPLING FOR AIRBORNE RESPIRATORY VIRUSES IN AN EXPERIMENTAL MEDICINE PIG HANDLING FACILITY, SINGAPORE

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The Use of Bioaerosol Sampling for Airborne Virus Surveillance in Swine Production Facilities: A Mini Review

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Other Respiratory Virus Aerosol Detection Research

Duke University Emergency Department

Singapore's KK Women and Children's Hospital

Schools in Kunshan, China

Singapore MRT

Our One Health Training

One Health Training Program

4 graduate courses (May 17 through June 10, 2018)

- An Introduction to One Health Problem Solving (2 credits)
- Public Health Laboratory Techniques (1 credit)
- An Introduction to Entomology Zoonotic Diseases & Food Safety (3 credits)
- Introduction to Environmental Health (3 credits)

The 2018 Duke One Health Training Program class included 31 scholars from eight countries: China, Egypt, Lebanon, Morocco, Pakistan, Sri Lanka,The Philippines, and the USA.

One Health Training

- Epidemiology
- ID surveillance
- Analytical epidemiology
- Outbreak response
- Zoonotic diseases
- Entomology
- Food safety
- Viral culture
- Molecular diagnostics

- Ecology
- Serologic assays
- Modern dairy production
- Mosquito & tick collection
- Mosquito & tick control
- Modern meat production
- Aquaculture
- Environmental engineering

Duke One Health Training Program Alumni Distribution Map, 2008-2018

Note that early training was performed at University of Iowa (2008-9) or University of Florida (10-14) under similar summer short course programs as led by Professor Gray

Recent novel pathogen detection workshops

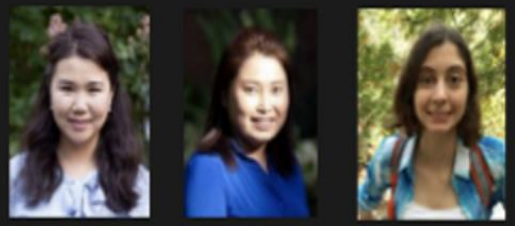
One Health Fellowships for Zoonotic Disease Research in Mongolia, NIH D43TW009373

Partners:
Institute of Veterinary Medicine
National Center for Zoonotic Diseases

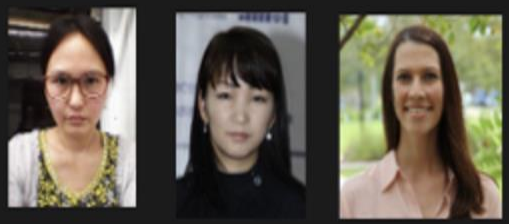
- **2 Months of One Health Training at Duke University**
- **22 Months of mentored research at the National Center for Zoonotic Diseases in Mongolia**

Our long term goal is to develop a Global Health Training Program that elicits innovative, multidisciplinary team problem-solving solutions to develop products, alter disease processes, and guide policies in controlling zoonotic diseases in Mongolia.

Team 1 (2014-16):
Tick-borne Diseases



Team 2 (2015-17):
Zoonotic Influenza Surveillance



Team 3 (2016-18):
Zoonotic Parasite Ecology/Epidemiology

Team 4 (2017-18):
Zoonotic Surveillance of Mosquito-borne Arboviruses

USA and Mongolia - NIH D43TW009373 (2014-2018) Team 1:
Emerging Tick-Borne Pathogen threats in Mongolia: An Investigation Implementing a One Health Framework

Primary goal is to investigate the epidemiology of tickborne pathogens in differing Mongolian landscape types (forest, grassland, and a peri-urban area) & among people, livestock, wild rodents, and ticks.

USA and Mongolia - NIH D43TW009373 (2014-2018)

Team 2: Detecting Influenza Virus in Rural Mongolia

We seek to demonstrate that it is possible to provide rapid diagnoses of human or animal influenza in rural settings such that human, public health and veterinary health officials may more rapidly respond with antivirals (for humans), seasonal influenza vaccine (for humans), or equine influenza vaccine (for camels or horses).

USA and Mongolia - NIH D43TW009373 (2014-2018)

Team 3:

Emerging Zoonotic Enteric Parasite Disease Ecology and Epidemiology in Mongolia

Primary goal is to investigate the epidemiology of zoonotic parasitic pathogens (*Cryptosporidia* spp., *Entamoeba histolytica* , Giardia spp., in human, animals, and rodents so as to suggest changes in medical policy in Mongolia

Summary

One Health is an exciting research and training area.

One Health training is a good investment in your professional future as considerable employment, research, and training await those who are trained in One Health